## Table of Contents

**Section** **Page**

## APPENDICES

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AMEC | AMEC Earth & Environmental, Inc. |
| AO | Administrative Order |
| ESD | Explanation of Significant Differences |
| FFS | Focused Feasibility Study |
| FS | Feasibility Study |
| fps | feet per second |
| LNAPL | Light Non-Aqueous Phase Liquid |
| Ogden | Ogden Environmental and Energy Services Co., Inc. |
| NGVD | National Geodetic Vertical Datum |
| NPL | National Priorities List |
| PADEP | Pennsylvania Department of Environmental Protection |
| PCB | Polychlorinated Biphenyl |
| PDI | Pre-Design Investigation |
| PennDOT | Pennsylvania Department of Transportation |
| ppm | parts per million |
| PRWM | Pennsylvania Residual Waste Management |
| NPDES | National Pollutant Discharge Elimination System |
| RAC | Remedial Action Contractor |
| RCRA | Resource Conservation and Recovery Act |
| RDWP | Remedial Design Work Plan |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| TCLP | Toxicity Characteristic Leaching Procedure |
| USCG | United States Coast Guard |
| USEPA | United States Environmental Protection Agency |
| UST | Underground Storage Tank |

## 1.0 INTRODUCTION

This Revised Design Report has been prepared by AMEC Earth & Environmental, Inc. (AMEC), formerly Ogden Environmental and Energy Services Co., Inc. (Ogden), in accordance with the Administrative Order (the AO), Docket No. III-98-082-DC, issued by the United States Environmental Protection Agency (USEPA) on June 26, 1998, the Final Remedial Design Work Plan (RDWP) (dated August 16, 1999) for the Metal Bank National Priorities List (NPL) site located in Philadelphia, Pennsylvania, and the Consent Decree between the United States and the Third-Party Defendants in United States v. Union Corporation, Civ. No. 80-1589 (E.D. Pa.) (the "Utility Group Consent Decree"). The RDWP for the Metal Bank NPL site was prepared by Ogden and Hart Crowser, Inc. (Hart Crowser) under the AO for the Respondents that are members of the Utility PRP Group (PRP Group Respondents). The Ogden (now AMEC) and Hart Crowser team was approved by USEPA on September 22, 1998, to design the remedy selected by USEPA for the Metal Bank NPL site. The revisions to the Final Design Report were prepared by AMEC without assistance from Hart Crowser.

The Remedial Design project is being conducted in three phases. The Pre-Design Investigation (PDI) phase was conducted to collect engineering data to support the design of the remedy. The Remedial Design phase includes the efforts necessary to prepare design reports, engineering design drawings, construction specifications, and associated site work plans. This Revised Design Report incorporates the revisions to the Final Design based on negotiations between the Cottman Avenue PRP Group and the USEPA to develop the Revised Remedial Plan. This report was prepared in accordance with the Record of Decision (ROD) for the site (issued by USEPA on December 31, 1997), the Explanation of Significant Differences (ESDs) for the site (issued by USEPA on September 27, 2000, and December 18, 2000), the Utility Group Consent Decree, including the Draft Revised Remedial Plan (dated June 29, 2004), the AO for the site, and applicable guidance documents and regulations. The Pre-Design Investigation Report (PDI Report) was submitted on January 21, 2000; the Preliminary Design Report was submitted on March 6, 2000; the Intermediate Design Report was submitted on March 5, 2001; the Pre-Final

Design Report was submitted on March 28, 2002; and the Final Design Report was submitted on September 16, 2002 and approved by the USEPA in January 2003.

As determined during the PDI, some conditions at the site have changed since the Remedial Investigation (RI) and supplemental investigations upon which the 1997 ROD was based, and additional site-specific information was necessary to prepare the design. In addition, remedial technologies continue to evolve and change. Therefore, this Revised Design Report and its contents have been prepared to address and account for current conditions and technological developments.

The first draft of the Revised Design was submitted to the USEPA on April 14, 2006 and the second draft of the Revised Design was submitted to the USEPA on February 16, 2007. Per the USEPA's request, the Revised Design was submitted to the USEPA on February 16, 2007, and the Remedial Action Work Plan (RAWP) was submitted in stages on March 2 and March 6, 2007. Following the receipt of the USEPA's comments to the Revised Design and RAWP, dated July 20, 2007, additional focused meetings (August 21 and September 6, 2007) were held between the USEPA and the PRP Group to discuss design and construction issues related to the Revised Design and the RAWP. As a result of these meetings, the PRP Group Respondents agreed to further amend the Revised Design and amend the RAWP to incorporate additional changes set forth during the August 21 and September 6, 2007 meetings. This is the third draft of the Revised Design to be submitted to the USEPA.

The Revised Remedial Plan, USEPA's comments to the Revised Design dated July 12, 2006, the PRP Group's Response to Comments dated August 14, 2006, the Summary letter regarding Response to Comments discussions between the PRP Group and the USEPA dated January 16, 2007, the USEPA's comments to the Revised Design and RAWP dated July 20, 2007, and the PRP Group's Response to Comments dated November 9, 2007, are included in Appendix 2 of Volume I.

## 1.1 Revised Design Objectives

The purpose of the Revised Design is to finalize the approaches presented and accepted in the Final Design process and the Revised Remedial Plan. The objectives of this Revised Design Report are:

- To present the design concepts and general objectives included in the design of the ROD remedy as revised by the ESDs, the Revised Remedial Plan, and the USEPA's interpretations thereof, including responding to the USEPA's comments dated July 12, 2006 and July 20, 2007.
- To provide the revised final design drawings.
- To present the remediation plan for the site with the supporting details that will allow USEPA approval of the Revised Design.
- To provide the revised specifications.
- To present the revised Work Plans required by the AO for USEPA review and comment.

Further details regarding a description of the project and the project objectives are contained in the Remedial Investigation, the Feasibility Study, the ROD, the ESDs, the AO, the RDWP, the PDI Report, the Intermediate Design Report, the Pre-Final Design Report, the Final Design Report, and the Revised Remedial Plan for the site.

## 1.2 Definition of Terms

Throughout this document, there are names of the parties that will be involved with the construction. For clarity, these terms are defined as follows: The term "USEPA" refers to the Federal Agency that has the responsibility to review and approve design and construction documents as part of the remedial action construction work and has overall approval authority for all remedial action construction activities. The terms "Contractor or RAC" refers to the Contractor that will perform the remedial action construction work and includes any subcontractors, including the independent third-party licensed survey firm. "Client" refers to the

Utility Group. The term "Supervising Contractor/Site Construction Manager" refers to the engineer or oversight firm that works on behalf of the Client to ensure the Contractor performs the work in accordance with the design documents.

## 1.3 Report Organization

Volume 1 of this Revised Design Deliverable contains the Revised Design Report. Section 2.0 of this report provides a brief discussion of site background and current conditions to provide background for any parties that are not familiar with the project. Section 3.0 discusses the Explanations of Significant Differences, the Revised Remedial Plan, Changes to the Design that are Contrary to the Settlement Agreement and the resulting impact of these design concepts contained in these documents to the design. Section 4.0 discusses the project design elements. Section 5.0 discusses the design components, including design drawings and the project specifications, work plans, cost estimate, and schedule. Section 6.0 summarizes these design deliverables. Section 7.0 lists references used to prepare this report. This report also includes appendices, and two additional volumes. Volume 2 contains the Revised Final Work Plans. Volume 3 contains the Final Revised Construction Specifications.

# 2.0 SITE BACKGROUND AND CURRENT CONDITIONS

This section provides a discussion of the site location and description, a summary of the site's previous ownership and use, a summary of the previous site investigations, and a description of the current site conditions.

## 2.1 Site Location and Description

The site is located on the western shore of the Delaware River in a heavily industrialized section of northeastern Philadelphia, Pennsylvania (see Drawing S-1 in Appendix 1 of Volume I). The northern portion of the site is located on relatively unaltered river shore deposits, in comparison to the remainder of the site. The larger southern portion of the site is located on reclaimed riverbed/mudflats and consists of artificial fill and construction debris placed onsite over time. The site is inactive, with one building and six building foundations, and a 6-foot-high fence that restricts access, but is in fair to poor condition and does not completely surround the site. The site is bordered by Cottman Avenue and a mudflat on the west, Milnor Street on the north, Safe Disposal Systems, Inc. (a white-goods/appliance recycling operation formerly Hancock Paper Company a paper recycling company) and Morris Iron & Steel Company (a metal salvage yard) on the east, and the Delaware River on the south. St. Vincent's School is located to the west of the site across Cottman Avenue and currently appears to operate as a day care center. A City of Philadelphia combined sewer outfall that empties into the mudflat area is located at the southern end of Cottman Avenue. A marina is located adjacent to the mudflat farther to the west.

The site consists of three areas of concern: (a) the Courtyard Area, located on the northern portion of the property (see Drawing S-2 in Appendix 1 of Volume I); (b) the Southern Area, a former scrap metal recovery area, located on the southern portion of the property; and (c) the Delaware River Sediments Area.

The Courtyard Area consists of six former building foundations and concrete floor slabs and one existing steel-framed building on approximately 2.5 acres of land located on the northern end of

the site near Milnor Street. The basements or belowground portions of the building have been filled with demolition materials, including bricks and block. Building 7 remains onsite. The buildings were located around an open area (the Courtyard Area) that provided access to Buildings 2 and 7 for rail cars and trucks. According to the Site Owner, Buildings 2 and 7 were at one time used for electrical transformer recycling activities.

The Southern Area is approximately 9 acres in size. Currently, most of the Southern Area is graded and vegetated primarily with grasses and heavier vegetation along the perimeter. The Southern Area is approximately 10 to 15 feet above the water level of the Delaware River, which is influenced by tidal fluctuations of 6 to 7 feet in the area of the site. The outer slope on the southern and western sides is steep, with large concrete block material apparently placed for erosion control.

The Delaware River Sediments Area, located adjacent to the southern and western boundaries of the property and to the north adjacent to the Morris Iron & Steel property, consists of mudflats and river sediment. The mudflat area to the west of the site is a fairly flat, unvegetated area that is dry at low tide and under as much as 5 to 7 feet of water at high tide. From the combined sewer outfall along the shoreline to the south, the material consists of a coarse gravel and cobble material with debris throughout. Farther from the site, the material consists of a finer sediment. The Delaware River along the southern boundary of the site and adjacent to Morris Iron & Steel consists of a gradually sloping river bottom with a gravely and sandy material. The flat surface along the shoreline is also exposed at low tide and under as much as 7 feet of water at high tide.

The Delaware River Sediments area was subdivided into two separate areas during the above referenced meeting between the USEPA and the PRP Group on September 6, 2007. The sediment excavation and backfill area, also referred to as the Mudflat area, includes the area that is approximately 75 feet from the shoreline and is mostly accessible during low tide events where sediment will be excavated to a two foot depth and backfilled with 1-foot of riprap material. The sub-aqueous cap areas, also referred to as the Delaware River North and South areas, include three separate areas that are mostly underwater during regular tidal cycles where

all three areas will receive a sub-aqueous marine mattress cap placed over the existing sediment material.

## 2.2 Site Ownership Summary

The ownership of the site was traced to the period between 1882 and 1928, when the site was acquired by a power equipment manufacturing company from unknown prior owners in several separate transactions. The power equipment manufacturer retained ownership of the site until 1955, although reports indicate that some portion of the site was owned by a federal agency between 1928 and 1955. In 1955, the site was sold to a new owner who, in turn, sold the property in October 1962 to the predecessor to Metal Bank of America, Inc. Metal Bank of America, Inc. was acquired by The Union Corporation in 1968, at which time Irvin and John Schorsch took ownership and The Union Corporation became a lessee of the property. The Schorsch brothers sold the property to the Philadelphia Authority for Industrial Development in 1980, at which time Metal Bank became the equitable owner. The corporate successor to Metal Bank, U.C.O.-M.B.A. Corporation, took title to the site in January 2001. As part of a bankruptcy reorganization in 2003, the site owner became the Union Trust.

## 2.3 Site History

The available records are unclear as to what, if any, manufacturing or related activities took place on the site before 1955, the period when the site was owned by the power equipment manufacturing firm. Similarly, when the property was under new ownership between 1955 and 1962, available records do not specify site use. However, beginning in 1962, with the site purchase by the predecessor to Metal Bank, until 1979, reports indicate that the site was used for the storage and reclamation of various scrap metals. According to a USEPA letter dated July 12, 1979, onsite Metal Bank activities had ceased by that date. However, reports suggest that the site was used as a storage facility for scrap metal until as late as 1984 or 1985. Aerial photographs indicate there was also a large automobile parking area in the Southern Area at one time.

Electrical transformer salvage operations were conducted at the site from at least late 1968 or early 1969 until early 1973. Some of the transformers handled at the site may have contained polychlorinated biphenyl (PCB)-bearing oil, and it is reported that oil from the transformers was drained onto a graded concrete pad that was connected to an underground storage tank (UST). Spills of the oil and an alleged release, or spills and overfills from the UST, may have caused soil and groundwater contamination at the site. Furthermore, as part of the metal recycling activities during the period from 1968 to 1972, copper wire may have been burned at the site to remove insulation in preparation for copper reclamation.

The investigative and enforcement history of the site began in 1972 when reports of oil seeping from the banks of the Delaware River at the Metal Bank Site prompted the United States Coast Guard (USCG) to conduct a series of visual inspections of the Metal Bank Site and the Delaware River bank. The site has been investigated since that time, and a summary of the previous investigations can be found in the RDWP dated August 16, 1999, the PDI Report dated January 21, 2000, and the USEPA's 2003 Pre-Remedy sampling event.

## 2.4 Areas of Concern and Current Site Conditions

Based on the USEPA's 2003 Pre-Remedy sampling event findings, the PDI Report findings and previous investigations, there are seven areas of concern where PCBs have been identified in several site media that the USEPA has determined must be addressed by the Remedial Design. These areas of concern include the following:

- The Courtyard Area soils above the ROD action level of 10 parts per million (ppm) for PCBs.
- The Courtyard Area building foundations and the interior of Building Number 7.
- The Southern Area subsurface soils above the ROD action level of 25 ppm for PCBs.
- The UST in the Southern Area.
- The Southern Area subsurface where light non-aqueous phase liquid (LNAPL) is present.
- The riprap along the shoreline of the Delaware River and mudflat area.

- The mudflat area and the Delaware River sediments above the ROD action level of 1 ppm for PCBs.

The Courtyard Area soils were previously identified as having PCB concentrations above 10 ppm in two localized areas identified as CY-1 and CY-2 on the drawings in Appendix 1 of Volume I. The Courtyard consisted of an area surrounded by buildings on the west and south, a property line and fence to the north and east, and an entrance way from Cottman Avenue to the southwest. Milnor Street is also located to the north. Except for Building Number 7, the buildings were demolished by the Site Owner in the fall of 1999, and the Courtyard is now surrounded by concrete slabs and foundations to the west and south. The surface of the Courtyard Area is heavily overgrown with brush and trees. The surface consists of the remnants of old deteriorated pavement, gravel, and soil.

The Southern Area subsurface soils were previously identified as having PCB concentrations above 25 ppm in localized areas identified as SA-2, SA-3, and SA-4/5 on the drawings in Appendix 1 of Volume I. The largest area of concern in the Southern Area is an area of contamination surrounding the existing UST, which is believed by USEPA to be part of the source of contamination at the site. The UST was covered by 3 to 4 feet of fill, a large concrete pad, and a 6- to 12-inch imported soil cap. The Southern Area consists of an approximately 9-acre flat field. The area is approximately 500 feet wide from northeast to southwest by 800 feet long from northeast to southeast. To the northeast, the site is bordered by a chain-link fence. The Southern Area is bordered by the Delaware River to the southeast and the mudflats to the southwest. The area is vegetated with natural grasses and sparse trees. The higher grasses were cut after the PDI field work was completed, apparently by the Site Owner. The perimeter of the site on the southwest and southeast sides is vegetated with more dense trees and a steep slope of approximately 10 to 15 feet down to the Delaware River water level. The slope consists of concrete rubble along the mudflats and larger concrete blocks along the Delaware River.

The mudflat area (sediment excavation and backfill area) was identified as having more than a few discrete locations with PCB concentrations above 1 ppm. The mudflat area is a flat area

approximately 5 to 7 acres in size located adjacent to the site and the Delaware River. At high tide, the area is completely submerged. At low tide, the area is above the Delaware River water level. The area along the Metal Bank shoreline consists of concrete rubble above the water level and riprap, concrete, blocks, bricks, and cobbles mixed with gravels below the water level at high tide. Farther from the site, the area consists of finer grained sediments. It is believed that the combined sewer outfall in this area may have been constructed with a gravel pavement consisting of riprap, cobbles, and blocks for erosion control.

The Delaware River to the north and south of the site (sub-aqueous cap areas) consists of a shoreline similar to the mudflat area, with some larger concrete blocks and then a gradually sloping bottom at approximately a 10-percent slope away from the site. In some areas, the slope is greater, reaching a depth of more than 15 feet below mean sea level within approximately 100 feet of the site. The area down river from the site beyond Saint Vincent's School consists of a private boat launch and a public boat launch. Many recreational boats were moored in the Delaware River off the Metal Bank shoreline at the time that the PDI was performed. The Contractor will be required to notify the Quaker City Yacht Club before construction to arrange having the boats moved to an alternate location during construction, if necessary.

# 3.0 EXPLANATION OF SIGNIFICANT DIFFERENCES (ESD), USEPA COMMENTS, THE REVISED REMEDIAL PLAN, AND NEGOTIATIED CHANGES TO THE SETTLEMENT AGREEMENT

The PRP Group Respondents proposed modifications to the 1997 ROD remedy in the Preliminary Design submitted in March 2000. These modifications were first discussed with the USEPA at a number of meetings and then re-proposed in Section 4.0 of the Intermediate Design Report. The modifications that were proposed are listed as follows.

- Excavation instead of LNAPL Collection System
- Optimization of the Sheet Pile Wall
- Performance Standards for the Sediment Excavation
- Dredging in Wet Conditions
- Elimination of the Soil Monitoring Program.

The USEPA conducted a review of the Preliminary Design and contracted with CDM Federal Programs to prepare a Focused Feasibility Study (FFS), the final version of which is dated November 10, 2000. The FFS was first issued in draft format in June 2000, and comments were provided by the PRP Group Respondents' consultants and the Site Owner Group's consultants. AMEC (then Ogden) also issued reports on April 24 and August 24, 2000 to assist the USEPA in preparation of the FFS. On September 27, 2000, and December 18, 2000, the USEPA issued two separate ESDs to address changes to the 1997 ROD remedy. The impact of the ESDs on the design is discussed below.

## 3.1 Explanation of Significant Difference Number 1

In the ESD dated September 27, 2000, the USEPA addressed changes to the 1997 ROD remedy in the following areas.

### 3.1.1 Optimization of the Sheet Pile Wall

The PRP Group Respondents had proposed optimizing the sheet pile wall in the two ways outlined below.

#### 3.1.1.1 Sheet Pile Wall Length

The PRP Group Respondents proposed shortening the sheet pile wall length to limit its installation to the areas where LNAPL was identified and to adjust the location of the sheet pile wall so that it would be installed at the toe of the slope to contain the boulders and riprap material that was considered an area of concern in the ROD. This proposed change to the length was not addressed in the first ESD that was issued on September 27, 2000; however, it was addressed in the second ESD issued by the USEPA on December 18, 2000.

#### 3.1.1.2 Sheet Pile Wall Placement

Section IX.B.5 of the 1997 ROD states, "Oversize materials such as boulders in the Riprap Area and debris from the Southern Portion shall be decontaminated, using steam cleaning or other equivalent method, in order to reduce PCB concentrations." The USEPA determined that the remedy in the 1997 ROD should be modified to allow the sheet pile wall to be placed at the toe of the riprap. This will allow the oversize material containing PCB contamination to be contained behind the sheet pile wall and eliminate the need for decontamination of the riprap. Drawing C-26 in Appendix 1 of Volume I shows the location and extent of the sheet-pile wall at the toe of riprap. Once in place, the sheet pile wall would contain any PCB contamination that exists on the surface of the oversize material and prevent migration of the PCBs to the Delaware River. The area behind the sheet pile wall will be filled with clean imported fill, if necessary, or with sediment excavated from the Delaware River if the sediment is suitable for this purpose.

The location of the sheet pile wall at the toe of the slope was accepted with ESD #1. The length was not modified with ESD #1; however, the length was modified with ESD #2. The length of the sheet pile wall is shown on Drawing C-26 of Appendix 1 of Volume I. In addition, the USEPA expressed concerns regarding riprap contamination with the review of the Intermediate

Design. As a result of this concern and based on a June 2001 site visit by representatives of the USEPA and AMEC and the PRP Group Respondents, AMEC has added four riprap outfalls on the outer slope of the site to prevent erosion of the riprap areas outside the sheet pile wall. These riprap outfalls are shown on Drawing C-12 in Appendix 1 of Volume I.

### 3.1.2 Sediment Cleanup Level

In the Selected Remedy and Performance Standards, Section IX of the ROD, the area requiring cleanup is described as:

> Sediments within 100 feet of the Metal Bank Property and within four feet of the surface of the river bed shall be excavated. Sediments beyond 100 feet of the Metal Bank property which have PCB concentrations exceeding 1 ppm shall be excavated if USEPA determines during remedial design that such removal would be appropriate and feasible. Excavation of these sediments shall be performed after completion of soil excavation activities in the Southern Portion of the property. The extent of excavation shall be further defined during the remedial design and approved by the USEPA.

In ESD #1, the USEPA determined that the remedy stated in the 1997 ROD should be modified to require that only sediment with PCB contamination greater than 1 ppm within approximately 100 feet of the Metal Bank Site and within 4 feet of the surface of the river bed shall be excavated. Sediments beyond 100 feet of the Metal Bank Site that have PCB concentrations exceeding 1 ppm would be excavated if USEPA determines during remedial design that such removal would be both appropriate and feasible. This change is contingent on the assumption that sediment with PCB contamination above 1 ppm is clearly delineated during Remedial Design. Based on preliminary design sampling, it has been determined that excavating sediment containing greater than 1 ppm PCBs will result in the removal of more sediments that exceed the cleanup level, while leaving sediment below the cleanup level within the 100-foot zone undisturbed.

The USEPA accepted this change in ESD #1 because it still would meet the intent of the ROD. Additional revisions to the sediment excavation are set out in the Revised Remedial Plan, and are discussed in 3.3.6 below. The areas of sediment excavation and capping are shown on Drawings C-32 and C-33 in Appendix 1 of Volume I. These drawings also show the locations of confirmatory samples for the sediment excavations proposed by the PRP Group Respondents in the Intermediate Design, additional locations required by the USEPA in correspondence dated August 24, 2001, and locations identified in the Revised Remedial Plan.

### 3.1.3 Coffer Dam Construction

The 1997 ROD requires the construction of a temporary coffer dam so that sediments can be dewatered prior to excavation. In ESD #1, USEPA determined that the remedy stated in the 1997 ROD should be modified to allow excavation without dewatering the area of excavation. USEPA required the use of low-impact excavation equipment in combination with turbidity curtains in lieu of coffer dam construction. A turbidity curtain around the entire excavation area and an inner curtain around the work area would need to be installed to protect the environment from release or migration of PCB contamination. In addition, during excavation, monitoring will have to be performed downgradient from the sediment area to monitor sediment transport. During the Pre-Final Design, specifications for turbidity monitoring and turbidity barriers were developed. These specifications outline the requirements of the ESD. In addition, the specification for Sediment Excavation and Sub-aqueous Cap specifies the use of low-impact construction equipment to be used during sediment excavation. The construction specifications sections are included in Volume III of the Revised Design. This change was accepted in ESD #1.

### 3.1.4 Soil Monitoring Program

The 1997 ROD states that a soil monitoring program shall be developed during remedial design to monitor soil cover for evidence of upward migration of contaminants in groundwater caused by flooding conditions that may raise the water table. In ESD #1, USEPA determined that the remedy stated in the 1997 ROD should be modified to permit the use of a lightweight geotextile in lieu of soil monitoring. The geotextile would prevent the potential upward migration of PCB contamination attached to soil particles. In addition, the geotextile will provide a uniform consistent barrier and will allow for verification of the 2-foot soil thickness. It will also prevent the mixing of site soils with cover soils. Drawing C-24 of Appendix 1 of Volume I shows a detail of the cover system including the geotextile. Specifications for geotextile have also been developed. The construction specifications sections are included in Volume III of the Revised Design.

This change was accepted in ESD #1. It was determined by the USEPA that this change will meet the intent of the ROD.

## 3.2 Explanation of Significant Difference Number 2

In the ESD dated December 18, 2000, the USEPA addressed changes to the 1997 ROD remedy in the following areas.

### 3.2.1 Hot Spot Delineation and Confirmation Sampling

The 1997 ROD requires excavation of "hot spots," defined as Southern Area soils with PCB concentrations exceeding 25-ppm PCBs and Courtyard Area soils with PCB concentrations exceeding 10-ppm PCBs. The ROD requires the extent of the hot spots to be defined during the design. The ROD also requires confirmation sampling at the conclusion of the excavation to ensure the excavation is complete. In ESD #2, USEPA determined that the remedy stated in the 1997 ROD should be modified to allow confirmation sampling to be performed either before excavation activities or at the conclusion of excavation activities. If the confirmation sampling is

performed before the excavation, the limits of the hot spot excavation will be pre-defined for the excavation activities. If confirmation sampling is conducted at the conclusion of the excavation, verification samples will be collected at the base of the excavation and the sidewalls of the excavation before the excavation is closed. If the excavation continues to the water table, confirmation sampling at the base of the excavation will not be required. The USEPA has determined that either approach will be effective in determining if hot spots have been adequately identified for the excavation.

Based on the August 24, 2001 letter from the USEPA, the confirmatory sampling for the Courtyard Area was completed during the PDI with the exception of one location in the Courtyard Area at CYB 10. The confirmation sampling was complete in the Southern Area with the exception of three locations: SAB-12, SAB-15, and SAB-17. As agreed upon in the Consent Decree, confirmatory sampling in the Courtyard Area is no longer necessary as established excavation depths in "hot spots" CY-1 and CY-2 and the rest of the courtyard area instead of confirmatory sampling. The Revised Remedial Plan revises the confirmation sampling program as described in 3.3.1 and 3.3.5 below.

### 3.2.2 LNAPL Collection System

The 1997 ROD requires that an oil collection system be installed along the perimeter of the Metal Bank property to collect oil floating on the shallow groundwater at the site. The ROD envisioned the oil collection system would consist of interceptor trenches, oil/water separators, and sump pumps to be installed to collect floating oil from the shallow groundwater to prevent PCBs in oil from reaching the Delaware River. Collected oil would be required to be disposed offsite in accordance with Pennsylvania Residual Waste Management (PRWM) regulations. Incidental groundwater collected in the system would be discharged to the Delaware River if contaminant concentrations are within National Pollutant Discharge Elimination System (NPDES) discharge limits to be established or, if necessary, treated to meet discharge limits. During the Pre-Design Investigation, it was determined that oil present on the water table is limited to the area of SA-4/5. Therefore, in ESD #2, USEPA determined that the remedy stated

in the 1997 ROD should be modified to require the oil monitoring/collection system be installed only in the area of SA-4/5 where oil has been observed. Based on observations during trenching activities performed by the site owner, USEPA believes that removal of oil during the soil excavation may be more effective than the collection system outlined in the ROD. USEPA believes that a significant volume of the remaining oil at the site will be removed during the soil excavation. ESD #2 also requires that during the soil excavation the sidewalls of the excavation be visually inspected for the presence of oil flowing into the excavation. If oil is observed, appropriate steps will have to be taken to remove the oil during the excavation activities. This oil removal will be required even in the event that the confirmation sampling requirements described above have been satisfied. In addition, ESD #2 states that the excavation should remain open for a stabilization period of 2 to 3 days. After the stabilization period, the water surface at the bottom of the excavation should be observed. If oil is observed flowing into the excavation from a sidewall in a volume sufficient to cover the water surface with a measurable thickness of greater than 1/16 of an inch, then the ESD states the sidewalls of the excavation will have to be expanded beyond the pre-defined limits. If oil in a measurable thickness of 1/16 of an inch is not observed on the water surface after the stabilization period, excavation will be completed by backfilling, if the confirmation sampling requirements have been met. The Supervising Contractor/Site Construction Manager should also evaluate other alternatives for an additional stabilization period or LNAPL collection methods before backfilling and propose these to the USEPA during construction if they are appropriate. Any such alternative will require review and approval of the USEPA.

In addition to the removal of oil during excavation, USEPA believes that an oil monitoring component is still necessary if oil is present and if needed to ensure the remedy remains effective and the Delaware River is protected. Therefore, the ESD will require the construction of an oil monitoring system in lieu of a collection system. The oil monitoring system will be constructed to extend adjacent to the SA-4/5 area. The system will include a trench and sumps to be monitored for the presence of oil on a bi-weekly basis for the first quarter of monitoring and on a quarterly basis thereafter. In the event that oil is found in the sumps, it will be removed with sorbent booms. If the sorbent booms cannot adequately address the quantity, the monitoring

sumps will be equipped with collection devices. The monitoring sumps will be designed so that the sumps can be converted to oil collection devices. Drawing C-7 of Appendix 1 of Volume I shows the location of the LNAPL monitoring trench and sumps. Drawing C-23 of Appendix 1 of Volume I shows the details of the trench and sump, Drawing C-15 of Appendix 1 of Volume I shows a cross-sectional view through the LNAPL monitoring trench. A 24-inch HDPE pipe will be used for the construction of the monitoring sump. Specifications for the LNAPL monitoring system have been included in the Revised Design.

### 3.2.3 Sheet Pile Wall Modification

The ROD requires the installation of a sheet pile wall around the southern and western perimeter of the property adjacent to the Delaware River to prevent erosion of the fill material into the river and facilitate installation of the oil collection system.

The oil monitoring system will be limited to the area of SA-4/5. Therefore, to facilitate operation of the oil monitoring system, the sheet pile wall will be designed to encompass approximately the same limited area in the southwest corner of the site. However, the ROD envisioned that the sheet pile wall would also provide erosion control along the shoreline at the site. Therefore, because the length of the wall is being reduced, alternative erosion control measures will be required beyond the wall to reduce the potential of erosion in this area. The alternative erosion control shall incorporate maintenance of the existing vegetation between areas of excavation and the river, temporary erosion control structures around each excavation site, secured geotextile covers on any portion of the slope from the southern area to the river that must be cleared of vegetation, and supplemental riprap along the river where there are signs of bank erosion. Following completion of the remedial activities, all cleared areas should be revegetated. Based on the June 2001 site visit with the PRP Group Respondents and the USEPA, four locations for riprap outfalls have been selected and incorporated into the design.

During the Pre-Final Design, Drawings C-1, C-19, and C-20 (Appendix 1 of Volume I) were developed. These drawings show the locations and details of the erosion control measures that

will have to be taken by the Contractor. Super-silt fence will be used along the Delaware River and the mudflat area. A specification for sediment and erosion control that outlines the erosion control requirements of the ESD was developed. Drawing C-26 of Appendix 1 of Volume I shows the location of the sheet pile wall. The final elevation of the sheet pile wall was determined in the Pre-Final Design phase and is shown on the drawings.

### 3.3 Revised Remedial Plan

The USEPA and the PRP Group Respondents agreed to revise the final design plan for remediation of the site per an agreed upon Revised Remedial Plan that was negotiated and prepared during 2004. Following approval of the Final Design, additional site data were collected by the USEPA in the summer of 2003. Analysis of the new data, together with the continued evaluation of remedial options, led the USEPA and the PRP Group Respondents to jointly develop a revised remedial plan. The PRP Group Respondents agreed to revise the Final Design and incorporate the changes set forth in the Revised Remedial Plan document, submit the Revised Design to the USEPA for review/approval, and implement the remedy set forth in the Revised Design in accordance with the Revised Remedial Plan.

The agreed upon site remedy incorporating the Revised Remedial Plan into the previously approved Final Design consists of the following elements:

- Excavation of Courtyard area soils, and placement of a soil cap over the Courtyard area and foundations of former Buildings 2, 3, 4, 5 and 6;
- Power washing and surface coating of Courtyard Building 7 floor slab;
- Installation of a sheet pile wall at the southwestern corner of the Site;
- Removal of the underground storage tank (UST) near the southwestern corner of the Site;
- Excavation of Southern Area “hot spots” SA-2, SA-3 and SA-4/5 and offsite disposal of those soils;
- Excavation of near-shore sediments and capping of other sediment areas shown in the past to contain total PCBs in concentrations greater than 1 part per million (ppm);

- Pre- and post-construction monitoring; and
- Institutional controls.

The clarifications or revisions to these elements provided for in the Revised Remedial Plan are discussed in further detail in the remainder of this report section.

### 3.3.1 Courtyard Soils

This remedial element has changed when compared to the Final Design. Two hot spot areas of PCB-contaminated surface soils in the Courtyard area (labeled CY-1 and CY-2) will be excavated to a depth of 2 feet below ground surface (bgs). The excavated soil from CY-1 and CY-2 will be disposed of offsite at an appropriately regulated receiving facility. The remainder of the Courtyard Area (other than building foundations and footers) will be excavated to a depth of 1 foot bgs. Excavated soils from outside of CY-1 and CY-2 containing less than 25 ppm of total PCBs may be placed into one of the Southern Area soil excavations at a distance of at least 100 feet from the river and mudflat, at least 4 feet above the top of the groundwater table, and beneath the soil cap. The entire Courtyard will then be backfilled to grade and a 1-foot soil cap will be placed over the area. Drawings S-4, C-4, and C-5 of Appendix 1 of Volume I show the revised area of the courtyard excavation. Drawings S-4 and C-11 of Appendix 1 of Volume I show the revised area of the courtyard to receive the 1-foot soil cap. Drawing C-10 depicting confirmation sampling locations within the Courtyard area has been deleted from Appendix 1 of Volume I. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

### 3.3.2 Courtyard Buildings

This remedial element was not originally part of the Final Design. The floor of Building 7 and the rail spur in Building 7 will be power washed and sealed with an appropriate coating to be selected by the Utility Group and approved by USEPA. Wash fluids will be treated onsite and discharged to the City sewer or disposed of offsite at an approved facility. The foundations of Buildings 2, 5, and 6 and the basements of Buildings 3 and 4, which contain demolition debris, will be capped with a 1-foot soil cap. No verification samples will be taken for the Courtyard buildings. Drawing S-4 of Appendix 1 of Volume I shows the revision pertaining to Building 7. Drawings S-4 and C-11 of Appendix 1 of Volume I show the revised area of the courtyard to receive the 1-foot soil cap. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design. Construction Specification 09901 "Special Coatings" for sealing within Building 7 has been added to the construction specifications that are included in Volume III of the Revised Design.

### 3.3.3 Sheet Pile Wall

This remedial element has not changed compared to the Final Design. A sheet pile wall will be installed around the southern corner of the Site as depicted in Drawings C-26 to C-31 of the Final Design. These drawings were not revised as part of the Revised Remedial Plan and are included in Appendix 1 of Volume I of the Revised Design.

### 3.3.4 UST Removal and Offsite Disposal

This remedial element has not changed compared to the Final Design. The UST will be removed and disposed of in accordance with the drawings and specifications in the Final Design. The drawings and any portions of specifications relating to the UST removal/disposal were not revised as part of the Revised Remedial Plan and are included in Appendix 1 of Volume I and Volume III of the Revised Design.

### 3.3.5 Southern Area Excavation

#### 3.3.5.1 SA-2

This remedial element has changed when compared to the Final Design. The SA-2 area will be excavated to the lateral extent and depths set forth in the Final Design. Soils excavated from SA-2 will be disposed of offsite. The deepest part of SA-2 is approximately 90 feet x 30 feet. The bottom of the deepest excavation shall be divided into three 30-foot grids. In each grid, one composite sample will be taken. Each composite sample will include five (5) grab samples randomly selected from the bottom of the excavation. The three composite samples from the bottom of the excavation will be analyzed for total PCBs as Aroclor by USEPA Method SW846-8082. After receipt of the sample results, one or more of the following will occur:

1. If total PCBs are reported below 25 parts per million (ppm) in all three of the composite samples, then the excavation will be backfilled with clean fill material.
2. If total PCBs are reported above 25 ppm in any one or more of the three composite samples, then excavation will continue downward 2 feet in each 30-foot grid with a sample result in excess of 25 ppm
3. For each grid where an additional two (2) foot depth of soil is excavated, an additional composite sample then will be taken at the bottom of the deeper excavation and will be analyzed as set forth above.
4. If total PCBs are reported below 25 ppm in the second round of verification samples, then the excavation will be backfilled with clean fill material.
5. If total PCBs are reported above 25 ppm in any of the second round verification samples, then the excavation of the 30-foot grid surrounding that sample will proceed downward to one (1) foot below the groundwater table. This will be the maximum depth of the excavation. Thus, the maximum depth of excavation will be limited to 1 foot below the water table (approximately 1-foot above mean sea level).

6. The SA-2 excavation then will be backfilled with clean fill material.

Drawings C-6 and C-16 of Appendix 1 of Volume I show the revised area of the possible additional excavation depth within SA-2. Drawing C-10, depicting confirmation sampling locations within the SA-2 area, has been deleted from Appendix 1 of Volume I. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

**3.3.5.2** SA-3

This remedial element has not changed compared to the Final Design. The SA-3 area will be excavated to the lateral extent and depths set forth in the Final Design. Soils excavated from SA-3 will be disposed of offsite. The maximum depth of excavation is already 1 foot below the groundwater table. Therefore, the excavation will be complete when performed as set forth in the Final Design, and no verification samples are needed. After the excavation depths have been achieved, the excavation will be backfilled with either sediment that has been excavated from the mudflats/river, soil from other areas (the Courtyard, certain portions of SA-4/5) that are authorized for redeposit onsite, or clean fill material. Drawing C-10, depicting confirmation sampling locations within the SA-3 area, has been deleted from Appendix 1 of Volume I. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

### **3.3.5.3** SA-4/5

This remedial element has changed when compared to the Final Design. The SA-4/5 area will be excavated to the lateral extent and depths set forth in the Final Design, as modified by the changes described below. The USEPA has designated seven specific areas into which SA-4/5 has been divided (E1 through E7). Drawings S-4, C-4, C-7, C-8, C-12, and C-15 from Appendix 1 of Volume I have been revised to reflect these seven areas within SA-4/5. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

A. Lateral Extent of Soil/Oil Excavation Toward River and Mudflat

The lateral extent of the SA-4/5 excavation will be extended by 10 feet northwest from the location of sample SAB-19C towards B-15 and west towards the sheet pile wall. In addition, the lateral extent of the SA-4/5 excavation will be further extended if one or more of the following three conditions are met:

(1) Oil is present and flowing in from the sidewall of the excavation in 1/16th-inch (or greater) thickness on the water table after 2 to 3 days of stabilization. If this condition exists, the excavation will continue in the direction of the sidewall that oil is flowing from until oil is no longer observed flowing into the excavation;

(2) The Utility Group decides to continue excavating in area E5 or area E3 toward the sheet pile wall to the toe of the slope; or

(3) Verification sampling demonstrates PCB levels at or above 25 ppm along the sidewall.

B. Excavation Below the Groundwater Table

Area E7 (comprised of E3 and E6) will be excavated to a depth of 5 feet below the top of the groundwater table, in the manner and under the conditions described below. USEPA and the Utility Group commit to work together to design and achieve such excavation in a reasonable, safe, and cost-effective manner. Area E7 will be excavated as follows:

(1) Excavation will occur in the area surrounding E3 and E6 to create a level, stable work platform for excavating equipment, at a height approximately 4 feet above the groundwater table (elevation 5 feet), and with a bench width of approximately 10 feet to 20 feet surrounding the excavation. This should remove some of the overburden sidewall pressure in the area.

(2) The surface area of the excavation area extending below the groundwater table will be defined by survey.

(3) Excavation will proceed in an approximate 20-foot-wide pass across the width of the excavation area closest to the river and mudflat using equipment determined to be technically feasible and effective. If successful, this pass will remove approximately one-third of the material desired (i.e., approximately 330 cubic yards).

(4) If the first pass is completed successfully, a second pass across the width of the excavation will be attempted.

(5) If the second pass is completed successfully, a third pass will be attempted.

(6) If the third pass is completed successfully, excavation will continue, advancing away from the river, until completing excavation of area E7.

(7) Once the excavation of area E7 is complete, including the stabilization and monitoring period, area E7 will be backfilled with clean, imported fill. Backfilling will take place using the excavation equipment only, without other means of compaction.

Each of the following conditions also will apply to the deep excavation of area E7:

(1) Unless required by the RAC and agreed to by the parties, no shoring of the excavation will be installed, and the deep excavation will take place in the wet (i.e., without dewatering).

(2) If the Supervising Contractor/Site Construction Manager and/or the Site Safety Officer determine that an excavation sidewall threatens to collapse in towards the open excavation area, or if other unsafe working conditions arise during excavation of a sidewall to the intended depth, a decision whether to continue or discontinue additional excavation of the sidewall in that area will be made by the Utility Group's Site Safety Officer and/or Supervising Contractor/Site Construction Manager in conjunction with USEPA.

(3) Surface groundwater will be pumped from the excavation only in an attempt to remove oil.

(4) Personnel will not be permitted to enter the excavation or stand above the excavation within a projected 3 to 1 slope from the toe of the excavation.

(5) No survey will be performed of the excavation bottom. Instead, the operator of the excavation equipment will use the equipment itself to judge the depth of the excavation.

(6) The RAC hired to perform the work will have the opportunity to review this approach and propose alternative approaches to improve its safety and effectiveness. The parties will consider other methods proposed by the RAC, but must mutually agree to the alternative method before proceeding with the plan.

(7) The total volume of excavated soils from area E7 is estimated to be approximately 1,000 cubic yards.

(8) The determination as to whether the excavation should be terminated for any of the above reasons, or for other good cause, should be made jointly by the designated representatives of USEPA and the Supervising Contractor/Site Construction Manager for the Utility Group. Disputes would be resolved

according to the dispute resolution procedures governing the remediation project.

(9) Once the excavation of area E7 is complete, including the stabilization and monitoring period, area E7 will be backfilled with clean, imported fill. Backfilling will take place using the excavation equipment only, without other means of compaction.

C. Capping of Surface Soils in Area E4 and in SA-4/5

Area E4 will be capped with 4 feet of clean soil placed over a geotextile liner. Other than a slight difference in height to maintain a level slope, the other portions of SA-4/5 (E1, E2, E3, E5, E6) will be capped with 2 feet of clean soil over a geotextile liner as depicted in the Final Design.

D. Verification Sampling

Verification sampling will be performed along the southwestern edge of the sidewall of SA-4/5, in an area bound approximately by sampling points SAB-19C and DOJ-7.

Verification samples will be collected using the excavator bucket from the onsite earth-moving equipment. Each sidewall verification sample will consist of one composite sample per 25 linear feet of the SA-4/5 excavated sidewall on the Mudflat side of the excavation. Each composite sample will consist of five randomly selected sub-samples of the exposed wall face collected at a minimum depth of 6 inches into the exposed wall face. The soil samples will be collected in accordance with appropriate sampling methods and analyzed for total PCBs by Aroclor method 8082 at an USEPA-approved laboratory. The excavator bucket will be decontaminated before obtaining any verification samples.

After verification sample analytical results are received, a decision whether additional excavation within the SA-4/5 area toward the sheet pile wall will then be made by the parties involved. If the composite sample is below 25 ppm total PCBs, the excavation will be complete. If the sample is above 25 ppm total PCBs, either the excavation will proceed at least an additional 10 feet towards the sheet pile wall, after which an additional sample will be collected, analyzed, and evaluated in the same manner as above or the excavation will continue to the toe of the slope in that 25-foot section of the sidewall without collection of additional verification samples.

E. Waste Pile Sampling and Disposal

The intent of the excavation of SA-4/5 is to remove the hot spot soils and dispose of this material offsite at a permitted disposal facility. However, USEPA will consider future proposals by the Utility Group to allow the following soils to remain onsite for use in the Southern Area excavations:

- Soils located on the inland side-slope of the excavation that are on the outside of the previously defined SA-4/5 area and that are excavated to provide a stable side-slope;
- Material consisting of the 6- to 24-inch cap previously installed across the site by the site owner; and
- The concrete pad that lies above the underground storage tank.

A decision on the ultimate disposition of the above excavated materials will be made only when more information is available showing that PCB concentrations are less than 25 ppm. USEPA will consider a program by the performing parties that includes detailed protocols for the sampling, staging, and disposal of such materials. Additionally, the performing parties must take into account that the interface between the 6- to 24-inch "cap" and the old surface contains dioxin concentrations of concern to USEPA. Therefore, USEPA will consider allowing the cap material to remain

onsite if the parties can demonstrate that concentrations of dioxins/furans are less than 5-ppb dioxin TEQ or the old cap material is placed under 4 feet of material and does not threaten groundwater.

### 3.3.6 Delaware River and Mudflat Sediments

This remedial element has changed when compared to the Final Design as referenced in Section 2.1.

#### 3.3.6.1 Sediment Excavation and Backfill Area

Sediments within the reach of land-based equipment above 1 ppm PCBs, approximately 75 feet from the shoreline and 2 to 4 feet from the surface, will be excavated and backfilled with 1-foot of Pennsylvania Department of Transportation (PennDOT) R-3 riprap underlain by a non-woven geotextile. The RAC's means and methods for sediment excavation are provided in the RAWP. The sediments will be transferred to the Southern Area of the site for dewatering and a minimal amount of RCRA/TCLP sampling of stockpiled sediments will be conducted, by TCLP extraction method 1311 and RCRA Metals analysis method 6010B at an USEPA-approved laboratory, prior to placement as backfill on the site. Dewatering liquids will be collected, treated and discharged to the City sewer, subject to receiving City approval, or otherwise properly disposed of.

Localized turbidity curtains and silt barriers will be installed around the approximate 75-foot excavation limit as displayed on Drawing C-35, and the excavation will be performed in small phases, to avoid the release of sediments to the river during excavation. Following excavation of the 75-foot zone, the area will be backfilled with Pennsylvania Department of Transportation (PennDOT) R-3 riprap underlain by a non-woven geotextile as detailed in the specifications. The backfill material will be approximately 12 inches thick. Drawings S-4, S-5, C-32, C-33, C-34, C-35, and C-37 of Appendix 1 of Volume I show the revisions

pertaining to the sediment excavation area and turbidity control. Drawing C-36, depicting turbidity curtain sections, has been replaced in Appendix 1 of Volume I with sediment excavation and sub-aqueous cap details. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

#### 3.3.6.2 Sub-Aqueous Cap Areas

A sub-aqueous marine mattress cap will be installed over areas outside the excavation zone that the Final Design identifies for remediation. A riprap buttress will also be placed at the toe of the slope, below the sub-aqueous cap, in order to provide additional slope stability for the sub-aqueous cap. Localized turbidity curtains will be installed around the sub-aqueous cap areas prior to placement of the riprap buttress or the sub-aqueous cap as displayed on Drawing C-35. The marine mattresses are a high strength geogrid that are filled with PennDOT R-3 riprap with a bottom attached non-woven geotextile as detailed in the specifications. The marine mattresses, when constructed, will be 12 inches thick and placed as detailed in the drawings and specifications. Drawings S-4, S-5, C-32, C-33, C-34, C-35, C-36, and C-37 of Appendix 1 of Volume I show the revisions pertaining to the sub-aqueous cap areas, the sub-aqueous cap verification sampling, and turbidity control. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design.

### 3.3.7 Monitoring Program

This remedial element has changed when compared to the Final Design. The parties agree that the purpose of the monitoring program is to determine the effectiveness of the remedy. USEPA will use these data to fulfill its statutory obligation to perform a Five Year Review of the remedial action to evaluate its protectiveness of human health and the environment. In order for USEPA to make this determination, monitoring is required as a remedy component. Drawings S-4, C-22, and C-23 of Appendix 1 of Volume I show the revisions pertaining to

the monitoring program. The corresponding construction specifications sections have been revised and are included in Volume III of the Revised Design. Specific monitoring details and designated sampling zones in and around the marine mattresses are to be provided in the Long-Term Monitoring Plan under separate cover.

#### **3.3.7.1** Groundwater Monitoring

Groundwater monitoring will be conducted to evaluate the effectiveness of the upland source removal on reducing concentrations of PCBs, dioxin, and PAHs in groundwater. The data gathered will also be used by USEPA in conjunction with the river monitoring to ensure the remedy remains protective of the nearby aquatic environment affected by the Metal Bank Site. The groundwater monitoring program will consist of the following:

(1) There will be six (6) monitoring wells in locations identified by USEPA (refer to Drawing S-4). The frequency of sampling and analysis will be quarterly sampling for the first 2 years following major physical construction, biannual sampling for the third year, and annual sampling for the fourth and fifth years.

(2) For the first 2 years (eight consecutive quarters), monitoring will consist of (a) quarterly sampling and analysis for Total PCBs as Aroclor (Method 8082); and (b) semi-annual sampling and analysis for SVOCs, PCB Congeners (Method 1668A) and Dioxins (Method 1613). For the third year, groundwater monitoring will consist of semi-annual sampling and analysis for Total PCBs as Aroclor (Method 8082), SVOCs, PCB Congeners (Method 1668A) and Dioxins (Method 1613). For the fourth and fifth years, groundwater monitoring will consist of annual sampling and analysis for Total PCBs as Aroclor (Method 8082), SVOCs, PCB Congeners (Method 1668A) and Dioxins (Method 1613). The sampling program may be modified after 5 years.

(3) The groundwater monitoring data will be evaluated to assess the remedy's success in removing the apparent source of contaminants to the aquatic environment.

### **3.3.7.2** River and Mudflat Monitoring

The remedial element of the monitoring program has changed when compared to the Final Design. As referenced below in Section 3.4.4, sampling of the sub-aqueous cap material has been amended to include visual observation of the sub-aqueous cap to verify that the cap is still in place. The monitoring program will also provide for sampling and analysis of sediments/sand material and the use of appropriate field-derived biota-sediment accumulation factors (BSAFs) to estimate invertebrate bio-accumulation potential. The method of collecting sediment samples will be determined by USEPA and the Utility Group in consultation with their experts. The river and mudflat monitoring program will consist of the following:

(1) Monitoring locations will include eight (8) sediment sample locations, including one far field reference sample, which will be provided in the Long-Term Monitoring Plan that will be submitted under separate cover.
(2) The frequency of sampling and analysis will be bi-annual sampling for the first 2 years and annual sampling for the third, fourth and fifth years. The sampling program may be modified or reduced after 5 years.
(3) Samples will be analyzed for SVOCs, PCB Congeners (Method 1668A) and Dioxins (Method 1613).
(4) The cap will be surveyed by visual inspection which includes physically walking (during low tide) on the cap within the 75-foot excavation area and checking for deficiencies and underwater inspections for deficiencies in the cap-only areas.
(5) The frequency of the visual inspection surveys will be annually for five years. The sampling program may be modified or reduced after 5 years.

USEPA has concluded that releases of contaminants from the Metal Bank Site have resulted in a risk to the aquatic environment. Because the PCB contamination co-occurs with the PAHs and dioxins, the river remediation targeting PCBs greater than 1 ppm will also result in the cleanup of PAHs and dioxin. Therefore, data from the long-term monitoring of sediment will be used to establish the effectiveness of the remedy on the river cleanup. For the contaminants without cleanup criteria - PAHs and dioxins - the sediment data will be evaluated qualitatively with the groundwater data to assess the remedy's effectiveness. PCB sediment data will be evaluated against the 1-ppm cleanup criterion to demonstrate that the remedy is effective with respect to the PCB contamination. The parties agree to discuss in good faith and to seek agreement on the final elements of the monitoring program, including, but not limited to, the frequency and methods of sample collection. Details of the above sampling including the frequency and methods of sample collection and designated sampling zones in and around the marine mattresses are to be provided in the Long-Term Monitoring Plan that will be submitted under separate cover.

### 3.3.8 Institutional Controls

This remedial element has not changed when compared to the Final Design. Limitations on future use of the site are an essential component to ensure the protectiveness of the remedy. The parties will take affirmative steps to ensure that appropriate institutional and engineering controls are placed on the property by:

(1) A request that Judge Giles include enforceable future use limitations of the site in any remedy order issued by the Court;

(2) Preparing documents necessary to ensure that the Court's remedy orders are enforceable against the current and future owners and operators of the site, and

(3) Enforcing the Court's orders, and assuring governmental entities with jurisdiction over the property enforce the Court's orders. Institutional and engineering controls to be implemented at the site will include marking of the geotextile liner under the soil cap in the Southern Area, a new fence around portions of the site, warning signs, and a public education program.

## 3.4 Negotiated Changes to the Settlement Agreement

The USEPA and the PRP Group Respondents agreed to amend the revised final design plan for remediation of the site per the agreed upon Revised Remedial Plan that was negotiated and prepared during 2004. Following the submittal of the PRP Group's Response to Comments dated August 14, 2006, that was prepared in response to USEPA's comments to the Revised Design submittal dated April 14, 2006, the USEPA and the PRP Group held several focused meetings (September 5 and October 10, 2006) to discuss design elements of the Revised Design. As a result of these meetings and later correspondence (PRP Group Summary Letter dated January 16, 2007), the PRP Group Respondents agreed to amend the Revised Design and incorporate additional changes set forth during said meetings. Some of the negotiated changes that pertain to the USEPA's comments, dated July 20, 2007, to the first Revised Design submittal were reflected in the RAWP submittal.

As referenced in Section 1, the Revised Design was submitted to the USEPA on February 16, 2007, and the RAWP was submitted in stages on March 2 and March 6, 2007. Following the receipt of the USEPA's comments to the Revised Design and RAWP, dated July 20, 2007, additional focused meetings (August 21 and September 6, 2007) were held between the USEPA and the PRP Group to discuss design and construction issues related to the Revised Design and the RAWP. As a result of these meetings, the PRP Group Respondents agreed to further amend the Revised Design and amend the RAWP to incorporate additional changes set forth during the August 21 and September 6, 2007 meetings.

The agreed upon amended site remedy incorporating the design elements that are contrary to the Settlement Agreement into the previously submitted versions of the Revised Design and the current Revised Design consists of the following elements:

- Bi-weekly monitoring of the LNAPL trench (if needed) for the first quarter of long term monitoring;
- Sampling of excavated sediments for RCRA/TCLP;
- Replacement of the previously approved sediment cap material with a riprap cap material
- Replacement of the riprap cap material with a sub-aqueous marine mattress cap;
- The placement of riprap backfill material with a geotextile in the sediment excavation areas. The sediment excavation area was separated from the sub-aqueous cap areas in terms of the actual material that would be used in either area to provide the sub-aqueous cap;
- Installation of a riprap buttress to provide additional slope stability support for the Sub-Aqueous Cap;
- Subaqueous Cap and Sediment Backfill long-term monitoring, and;
- Replacement of upland seed mixture.

The clarifications or revisions to these elements are discussed in further detail in the remainder of this report section.

### 3.4.1 LNAPL Trench Bi-Weekly Monitoring

As stated in Section 3.2.2 above, the frequency of monitoring the LNAPL trench (if needed) has been amended from quarterly monitoring to bi-weekly during the first quarter after installation and quarterly monitoring thereafter. This is a small remedial element change that does not particularly affect the Revised Design, and is only viable if the LNAPL trench is installed.

### 3.4.2 Sampling of Excavated Sediments

As stated in Section 3.2.6 above, this remedial element has been added to the sampling requirements of the overall remedial action. The excavated sediment that has been removed from the Mudflat and River areas of concern will be sampled for RCRA/TCLP parameters prior to being used for grading purposes. This may have an affect on the required amount of fill material that is needed for site grading and on the anticipated amount of transportation/disposal associated with the remedial action.

### 3.4.3 Replacement of Sediment Cap Material with Riprap Cap Material

This remedial element has changed when compared to both the Final Design and the Revised Design, as mentioned in Section 3.3.6 above. The previously approved sub-aqueous sediment cap material has been replaced with a riprap cap material. The replacement of cap material is a remedial element change that affects the Revised Design and may significantly affect the overall constructability and amount of capping material required to implement the remedial action. As stated in Section 3.4 above, the USEPA and the PRP Group Respondents agreed to replace the capping material as a result of discussions during meetings that were held in the fall of 2006.

The USEPA indicated that the capping material could be modified to a riprap stone material which is a reference to a Pennsylvania Department of Transportation (PennDOT) rock class size (i.e., R-3) that has a maximum dimension of 6 inches and a minimum dimension of 2 inches. The USEPA was in favor of this material substitution because it would answer several comments that were posed by Revised Design reviewers regarding the ultimate stability of the sediment cap material in the July 12, 2006 comment USEPA comment letter. As such, the PRP Group Respondents agreed to the cap material substitution. During the preparation of the February 2007 Revised Design, AMEC had modified the cap to include a minimum of 6 inches of coarse aggregate material followed by a minimum of 18 inches of R-3 stone material for a total minimum cap thickness of 2 feet. The previously proposed two-

layer cap system has been modified in the preparation of this Revised Design; the PRP Group has modified the cap to a marine mattress system that is further discussed in Section 3.4.4.

### 3.4.4 Replacement of the Riprap Cap with a Sub-Aqueous Marine Mattress

As mentioned in Section 3.4 above, the PRP Group Respondents agreed to further amend the Revised Design to incorporate additional changes set forth during the August 21 and September 6, 2007 meetings. The PRP Group Respondents issued a Basis of Design (BOD) Letter to the USEPA, dated October 30, 2007 (attached in Appendix 2) regarding the above–referenced preference of a marine mattress type sub-aqueous cap.

This letter addressed design issues related to the sub-aqueous cap that were raised during a meeting with the USEPA on September 6, 2007, between the USEPA and its technical consultants and the Group's technical consultants. The issues presented by the USEPA during the meeting centered on the flood flow stability, filter criteria, and slope/settlement stability of the sub-aqueous cap riprap and bedding layer material that was proposed in the revised remedial design submitted to the USEPA on February 16, 2007. As stated in the BOD letter, the primary design intent, namely physical isolation of the sediments and scour/erosion protection, is met by the proposed marine mattress modification. This modification was proposed for four primary reasons:

1. Provides a higher level of quality control regarding the consistency and uniformity of thickness of the cap during the construction;
2. Provides a higher degree of confidence that differential settlement will be minimized;
3. Decreases the potential for cost escalation due to unforeseen issues associated with cap installation; and
4. Decreases the amount of turbidity during cap placement.

The proposed 12-inch thick marine mattresses containing R-3 riprap would also address the engineering and constructability issues presented at the September 6th meeting as follows:

1. The FS values relative to the 100-year flood flow conditions for the R-3 riprap armor layer (now confined within the mattress) would now increase due to the confinement. Also, the proposed 12-inch thick armor layer is greater than the calculated required layer thickness of the R-3 riprap stone to provide sufficient protection against scour/erosion. The FS calculation sheets are provided in Appendix 7.

2. Attachment of a geotextile to the mattresses would adhere to the FHWA filter requirements for the design of riprap revetments, specifically, the requirements between the R-3 riprap compared to the geotextile and the geotextile compared to the existing sediments. During the September 6 meeting, the USEPA's experts requested to see the filter criteria calculation sheets. The FHWA Publication Number PB89-218424 was used for referencing filter design and fabric filter guidance. A filter criteria sheet for the marine mattress cap system is provided in Appendix 7.

3. The concept of installing a buttress (Section 3.4.7) at the toe of the slope for the sub-aqueous cap areas, to aid the prevention of sliding, was concurred with by the USEPA's technical experts in the September 6th meeting. In addition, a buttress is normally recommended for use with a marine mattresses capping system. The marine mattresses would also act as a single unit, thus providing some protection against differential settlement of the cap system.

The new cap will need to be closely monitored during placement. Diligent monitoring of the cap material during placement is needed in order to limit the amount of turbidity the cap material may cause during placement. The Remedial Action Contractor shall address any

contingency concerns and provide proposed corrective action, including marine mattress separations greater than 4 inches, within their work plan.

### 3.4.5 Sub-Aqueous Marine Mattress Material

This remedial element has changed when compared to both the Final Design and the Revised Design, as mentioned in Sections 3.3.6 and 3.4 above. The previously approved sub-aqueous sediment cap material is proposed to be replaced with a marine mattress suq-aqueous cap system, where the mattresses will consist of high-strength geogrid panels that are a minimum of 12 inches in thickness. The mattresses will be filled with PennDOT R-3 riprap underlain by a non-woven geotextile within the mattress. The replacement of the cap material is a remedial element change that affects the Revised Design by improving the overall constructability and decreasing the amount of capping material required to implement the remedial action.

### 3.4.6 Sediment Excavation Backfill Material

This remedial element has changed when compared to both the Final Design and the Revised Design, as mentioned in Sections 3.3.6 and 3.4 above. The previously approved sub-aqueous sediment cap material within the sediment excavation areas has been replaced with the verbiage “backfill”, where the sediment excavation backfill will consist of a PennDOT R-3 riprap underlain by a non-woven geotextile. The replacement of the cap material is a remedial element change that affects the Revised Design and does not significantly affect the overall constructability or amount of capping material required to implement the remedial action. As stated in Section 3.4 above, the USEPA and the PRP Group Respondents agreed to replace the capping material as a result of discussions during meetings that were held in the summer of 2007.

### 3.4.7 Riprap Buttress

As stated in Section 3.4 above, this remedial element has been added to the revised design. The previously approved sub-aqueous sediment cap material within the cap-only areas was modified and the buttress was added in support of that modification. The riprap buttress will consist of a PennDOT R-6 riprap in accordance with the drawings and specifications. The addition of the riprap buttress is a remedial element change that affects the Revised Design, aids in the overall constructability, and does significantly affect the amount of material required to implement the remedial action.

### 3.4.8 Subaqueous Cap Monitoring

This remedial element has changed from the Final Design. The monitoring of the sub-aqueous cap has been amended to include visual inspections. This is a small remedial element change that does affect the Revised Design. This remedial element change will have a small affect upon the anticipated amount of operation and maintenance associated with the remedial action. Details of the inspection will be provided in the Long-Term Monitoring Plan to be submitted under separate cover.

### 3.4.9 Replacement of Upland Seed Mixture

This remedial element has changed from the Final Design. The seed mixture application rates shall be in accordance with the USDA NRCS Vegetating with Native Grasses in Northeastern North America (1998) specific to the native warm season grasses in the Native Upland Wildlife Forage and Cover Meadow Mix and Pennsylvania Erosion and Sediment Pollution Control Manual dated March 2000 and the Penn State Erosion Control & Conservation Plantings on Noncropland Manual. The previous seed mixture was recommended by USEPA BTAG and the new revision will comply with the latest recommendation of USEPA.

# 4.0 PROJECT DESIGN ELEMENTS

The AO required the PRP Group Respondents, which subsequently retained Ogden (now AMEC) and Hart Crowser, to design the Remedial Action specified in the ROD for the Metal Bank Site. The AO also requires the Respondents to implement the ROD. AMEC and Hart Crowser conducted the PDI between September 1999 and January 2000 to comply with the RDWP and to gather the information necessary to prepare the Design. The methodologies used for conducting the PDI are detailed in the RDWP, Volumes I through V, which was finalized on August 16, 1999. The results of the PDI were presented to the USEPA in the PDI Report, Volumes I through III, which was submitted to the USEPA on January 21, 2000. As discussed in Section 2.4, based on the ROD, the findings of the PDI, the findings of the USEPA's 2003 Pre-Remedy Investigation, and the Revised Remedial Plan, there are seven areas of concern that must be addressed by the Remedial Design. To address these areas of concern, there are many design elements that must be developed to perform the construction work associated with the Remedial Action. This section includes a discussion of the project design elements that are being developed during the design process. In addition, this section of the report presents the general approach to other elements of construction. These design elements have generally been presented in the order in which they are likely to occur during construction. The RAWP submitted by the RAC will contain an actual remedial construction schedule.

## 4.1 Remedial Design Intent and Performance Standards

The 1997 ROD and the agreed upon Revised Remedial Plan (dated June 29, 2004), state that certain components of the remedial design are based upon performance standards that must be attained during the implementation of the remedial action. The performance standards are provided to allow the RAC to identify/propose alternative strategies, techniques, and construction methods that may differ from the approved design yet achieve the desired remedial result. The remedial design is not intended to dictate means and methods as these are typically best left to the RAC. This allows the RAC to implement preferred construction or innovative methods based on their experience while ensuring that the intent and performance requirements of the remedial design are met.

It's also been found that by giving the RAC flexibility in identifying the means and methods of construction to achieve specified performance standards, it can result in cost savings, increased contractor responsiveness, and improved quality. Deviations from the approved design must be reviewed by the Engineer and approved by the USEPA prior to implementation of said component.

## 4.2 Site Survey

AMEC and American Geotech completed the site survey and tied the site topography, property boundaries, buildings, sample locations, monitoring wells, piezometers, and other features into the Pennsylvania State Plane Coordinate System. The elevations at the site are tied into the National Geodetic Vertical Datum (NGVD, 1988). The coordinates of sample locations are reproducible and can be identified and located in the future with coordinates in three dimensions related to this control based on the State Plane Coordinates. The survey provides 1-foot contours of the topography and accurately locates the site features.

American Geotech also provided control for use by Hart Crowser and Aqua Survey to conduct the bathymetric survey of the Delaware River Sediments Area. This control was used to tie the bathymetric survey into the State Plane Coordinate System so that future sediment sample locations could also be located based on coordinates in three dimensions. American Geotech assisted with the bathymetric survey in the mudflat area by surveying the accessible areas at low tide. The bathymetric survey provides 1-foot contour intervals. This approach will allow previous sample locations to be identified in the future, if necessary.

The survey drawing forms the basis for the engineering design drawings used for this Revised Design. The design of the remedial action will be accurately located based on the coordinates of the sample points from the Pre-Design Investigation that are provided as part of the design with Drawings C-38 and C-39, which are included in Appendix 1 of Volume I of this Revised Design

Report. Drawing S-3 in Appendix 1 of Volume I is the survey control drawing, which will provide the survey control to the Contractor.

During the Intermediate Design, a specification for the site surveying work required during construction was developed. The survey specification identifies the method for determining earthwork quantities based on measurements and the volumes calculated by an independent licensed surveyor. The survey section also requires that surveys be performed prior to, during, and after construction and that the excavations be surveyed to verify that excavation to the required limits is achieved and documented. The construction specifications sections are included in Volume III of the Revised Design.

## 4.3 Traffic Control

AMEC has reviewed the traffic routes to and from the site. The site is located adjacent to a busy side road just off of Interstate Route 95. As stated in the PDI Report, there is limited room for traffic into and out of the site. Cottman Avenue is not a good access point to the site. The traffic and parking on Cottman Avenue for St. Vincent's School and the narrow alley will not provide an appropriate turning radius for truck traffic.

An existing curb cut along Milnor Street will be utilized for construction traffic to and from the site. This construction entrance is located approximately 100 feet from the intersection of Milnor Street and Cottman Avenue. Milnor Street is utilized as a high-volume truck route that, in this commercialized area, should not pose significant amounts of problems for site access. The entrance location will limit the interference with the traffic on Cottman Avenue and also provide a safe point of access for the site. According to the Pennsylvania Department of Transportation (PennDOT) District 6-5 County Coordinator, Milnor Street is not a Pennsylvania State Road and is regulated by the Philadelphia Streets Department.

At the existing curb cut construction entrance, a new access road through the Courtyard Area will need to be built and maintained for site access. The new access road will become permanent

once the remedial action is complete to assist with future monitoring. The construction entrance and access road are shown on Drawing C-3 in Appendix 1 of Volume I.

By using the existing curb cut as a construction entrance, obtaining a permit from the Philadelphia Streets Department should not be necessary. However, if the RAC decides to widen the existing curb cut, then an application for a new curb cut permit will need to be obtained from the Philadelphia Streets Department. The requirements of the curb cut permit are a plot plan with proposed truck traffic site circulation, including turning radii of the largest vehicles proposed, and any corresponding permit or review fees. This permit will be the responsibility of the RAC if it is determined that the existing curb cut cannot be used. If a permit is required a Traffic Circulation Study is typically required for construction by the Philadelphia Streets Department. This will also be the responsibility of the RAC.

For truck traffic exiting the construction entrance, a safe sight distance in both directions must be maintained. According to the Pennsylvania Code Title 67 Chapter 441.8, the Safe Sight Distance for combinations exiting onto a two-lane road is 675 feet to the left and 625 feet to the right for a posted speed limit of 35 miles per hour. These clearance distances must be maintained for drivers to avoid accidents. These distances were verified during the Pre-Final Design. Therefore, the RAC will not be required to provide signs and flagman for traffic protection and maintenance in accordance with the PennDOT requirement set forth in Publication 43 and Publication 90. According to the Philadelphia Streets Department, the PennDOT standards for traffic protection and maintenance are the same standards that the city utilizes.

The specifications (Volume III) include a section for access/haul roads and a detail for a construction entrance that show the requirements by which the RAC must abide during construction.

## 4.4 Erosion and Sediment Control

This section of the report addresses the erosion and sediment control devices that will be implemented on the upland work areas in accordance with ROD Section VIII.B.2. This section does not address the Delaware River area of the project, which is addressed in Section 4.13 of the report. Section 4.13 also addresses the additional riprap outfall protection on the down slopes that was evaluated by the USEPA and PRP Group Respondents during a June 2001 site visit to determine if any areas outside of the proposed sheet pile wall are eroding and need additional fortification. Revisions for the erosion control of the outslope are provided with the Revised Design on Drawing C-12 in Appendix 1 of Volume I.

One of the first elements of construction will be the installation of perimeter erosion and sediment control devices. Perimeter erosion control features may include a stone construction entrance, silt fence, hay bales, or other erosion control elements. Silt fence will be required to be installed around the downgradient perimeter of the site, as shown on Drawing C-1 in Appendix 1 of Volume I. Drawings C-19 and C-20 include erosion control details and have also been included in Appendix 1 of Volume I. The stone construction entrance will be required to be installed immediately adjacent to Milnor Street.

The design of site surface features includes more permanent erosion control components, utilizing turf reinforcement technologies and other Best Management Practices as encouraged by the Pennsylvania Department of Environmental Protection (PADEP) water quality regulations, 25 PA Code Chapter 102, and as discussed in the Permitting Requirements Plan in Volume II. These practices include the use of turf reinforcement fabrics in drainage channels and on any slopes to stabilize and control erosion at the site.

Based on discussions with the PADEP, silt fence will be adequate for erosion control at the site because the grades are gradual and none of the slopes should exceed 250 feet before the silt fence. The silt fence will be installed at the top of the slope around the perimeter of the site. In addition, super-silt fence will be installed on the river side of the site. This provision was added because the sediment could potentially contain PCBs, and it is in excess of the normal sediment

control procedures that would be required. In addition, because of the site's location within the flood plain, the 4:1 slope at the transition of the soil cap to the existing grade has been specified to include erosion control fabric. This provision is also in excess of the typical erosion control requirements.

The Permitting Requirements Plan includes a discussion of the erosion and sediment control permitting features and also includes an Appendix with a letter to the PADEP that was provided with the Intermediate Design. Based on discussions with the PADEP site contact, these provisions for erosion and sediment control are adequate as long as they do not change in a subsequent design phase.

## 4.5 Clearing and Grubbing

Clearing and grubbing is not considered to be a major component of the design, and a specification for the clearing and grubbing work required during construction has been developed. The clearing and grubbing specification requires the Contractor to clear all areas of the site necessary for construction activities. This is intended to include areas in the Courtyard Area as well as in the Southern Area where the soil cover will be placed. All material from clearing operations will be required to be shredded into chips, and the chips will be required to be dispersed beneath the soil cap. The construction specifications sections are included in Volume III of the Revised Design.

## 4.6 Sealing of Building 7

In accordance with the Revised Remedial Plan, the concrete and steel rail line inside of Building 7 will be powerwashed and seal coated. During the RI, chip and wipe samples were collected from within Building 7. The sampling results indicated that PCBs were present within the building. Based upon the Revised Remedial Plan, the Contractor shall powerwash and seal coat within Building 7. The Contractor is also required to collect and treat (or dispose of offsite) any

water from the powerwash operation. The construction specifications sections are included in Volume III of the Revised Design.

## 4.7 Courtyard Area Soil Excavation

In accordance with ROD Section IX.A.1, the soil sampling program for the Courtyard Area was conducted during the PDI to further refine the volume estimates and extent of soils exceeding the 10-ppm action level for PCBs established in the ROD that were identified during the Remedial Investigation (RI) and Feasibility Study (FS). Soil samples were collected around the outside perimeter of the areas of concern to determine the boundaries and limits for future remediation. The results of the sampling effort were successful, and the boundary and limits for future Remedial Design were determined. The area is slightly larger than the area identified in the ROD. Information obtained from the PDI has been used to develop the final design criteria for excavation, staging, waste disposal, and restoration of impacted soils in the Courtyard Area. As referenced in Section 3.3 above, the Revised Remedial Plan includes revisions to the courtyard excavations that are detailed in Section 3.3.1.

Drawings C-4 and C-5 in Appendix 1 of Volume I show the limits of the courtyard soil excavation that will be required to be performed by the Contractor as part of the remedial action. The Contractor will be required to survey the entire Courtyard Area and lay out the excavation with survey stakes prior to excavation and to excavate a 2-foot depth within the CY-1 and CY-2 areas. The Contractor will be required to excavate the remainder of the courtyard area as shown on Drawings C-4 and C-5 to a 1-foot depth. The Contractor will also be required to survey the area upon completion and obtain the Supervising Contractor/Site Construction Manager's acceptance of the survey prior to placement of backfill in order to confirm that the excavation was completed to the limits established on the drawings. The Revised Design specifications for the Earthwork, and Sampling and Analysis required during construction are included in Volume III of the Revised Design.

## 4.8 Soil Stockpile Area Construction

In accordance with the ROD, Section IX.B, soil excavated from the areas of concern will be stored in accordance with applicable regulations and sampled to determine the appropriate disposal methods. The volume of soil that is expected to be excavated for offsite disposal is approximately 13,000 cubic yards, and estimates are included in Appendix 5 of Volume I. It would be impractical to utilize roll-off storage containers, as over 900 roll-off containers would be required. Therefore, a temporary storage pad will be designed for stockpiling of the soil. The storage pad will be constructed of an impervious surface consisting of concrete and will have a containment curb around the perimeter. Drawing S-4 in Appendix 1 of Volume I shows the proposed location of the soil stockpile area and decontamination pad. The RAC's RAWP displays related construction details.

At the end of each day and during periods of rain, soil piles will be required to be covered with impervious tarps to prevent the infiltration of storm water. The storage pad will also drain to a collection sump where water will be pumped through a treatment system to treat water to discharge standards. The treated water will be sampled to confirm that it is below the discharge standard; and then discharged to the Philadelphia Water Department (PWD) sanitary sewer inlet during dry conditions as described in the specifications and permitting plan and in accordance with the permit requirements of the PWD. The Contractor will be required to provide any water storage necessary during construction using fractionalization tanks or other containers. The RAC's RAWP displays the treatment system that will be used for construction. These drawings were provided to obtain the discharge approval and discharge standards. Appendix 3 of Volume I contains the Baseline Monitoring Requirement Application Submittal to the PWD and the discharge requirements received from the PWD. The specification for Construction Water Management has also been revised to incorporate the discharge standards provided by the PWD in Appendix A of Volume 3. This specification is performance based and requires the Contractor to design and provide a construction water treatment system based on the Contractor's anticipated construction operation. The construction water treatment system will have to be designed by the Contractor to meet the PWD discharge criteria that are required. The

same treatment system will be used to treat any water from excavations and any water generated from dewatering sediments or placing sediments within the excavations. The Contractor has the option to contain construction water and dispose of it offsite at an approved facility instead of designing and providing a construction water treatment system.

The RAC's RAWP displays the soil stockpile area. The location of the soil stockpile area has been revised to be placed in the Southern Area based on the USEPA comments on the Intermediate Design. The RAC's RAWP will display the vehicle decontamination pad for vehicles leaving the stockpile area.

The Contractor will be given the option to alter the size of the soil stockpile area or propose an alternate stockpile area or method. The stockpile area will contain separate bins for segregating soil piles. The Contractor will also be required to verify the designed concrete pad is adequate for the equipment that the Contractor intends to use on the project. Any proposed alternate design will be subject to the approval of the Supervising Contractor/Site Construction Manager and the USEPA and will be required to be at least as protective of the environment as the proposed design.

At the completion of construction, the Contractor will be required to remove and dispose of the pad and sample beneath the pad to confirm contamination did not penetrate the pad. Pad disposal will be the Contractor's responsibility.

## 4.9 Sheet Pile Wall Installation

### 4.9.1 Sheet Pile Wall

In accordance with Section IX.C.1 of the ROD, the installation of a sheet pile wall with interlocking steel sheets is required around the southern portion of the site to control erosion and to assist with the collection of oil. In ESD #2 dated December 18, 2000, the USEPA revised the

requirements for the installation of an oil collection system adjacent to the sheet pile and amended the primary purpose of the wall to provide erosion control along the shoreline at the southwest corner of the site. Accordingly, the length of the wall has been adjusted so that it is limited to the area of the southern corner of the site where LNAPL has been detected and where PCB soil contamination exceeds 25 ppm. This change was made in coordination with the decision to relocate the oil monitoring system away from the wall to a location within the area of SA 4/5. The Contractor is required to install the sheet pile wall at the beginning of construction before excavation of SA-4/5 for erosion control. The SA-4/5 excavation may expand out to the sheet pile wall; consequently, any anchors or deadmen must be re-installed during backfilling after SA-4/5 excavation activities are complete. The sheet pile wall shall be installed with any necessary temporary provisions for support until the SA-4/5 excavation is complete and permanent reinforcement can be installed. The location of the sheet pile wall is presented on Drawing C-26 of Appendix 1 of Volume I.

Analyses were performed to determine an acceptable height and depth of sheet pile wall that would be both stable and cost-effective. The design was based primarily on the loading conditions required during construction and the tide fluctuation of the Delaware River. It was initially believed that the wall would be able to support sediment-offloading operations. The more detailed analyses performed during the final design phase indicate that such a design is not constructible with the type of sheet pile wall required for erosion control. The Contractor is instructed that additional loading of the wall above 150 pounds per square foot (psf), after backfill and compaction behind the wall is complete to the existing grades, will require additional reinforcement of the wall beyond that which is shown on the drawings. The Contractor will need to provide a signed/sealed design, prepared by a licensed professional engineer, for any modifications to the sheet pile wall reinforcement to the Engineer for approval. During backfill and compaction activities behind the sheet pile wall, the Contractor shall continue to monitor wall deflections in accordance with Section 02900 of Volume III. The Contractor shall take all measures to ensure that backfill and compaction activities behind the sheet pile wall do not compromise the integrity of the sheet pile wall. Details of the sheet pile wall are provided on Drawings C-26 through C-31 of Appendix 1 of Volume I.

To facilitate the stability requirements of the sheet pile wall, a tie rod and concrete deadman anchor system was selected. Originally, it was thought that this configuration would require significant excavation of contaminated soil and riprap along the existing river bank slope. Within the area behind the wall, the slopes allow for installation and controlled backfilling of anchors without major excavation. This type of anchor also provides a solution that is less expensive than such methods as A-frame or steel H-pile reinforcement. During construction, the sheet pile wall installation will be performed by driving. It will be necessary to carefully control backfilling above the anchor system to prevent bending of tie rods. The backfill below the mean high water elevation must be free flowing to promote drainage behind the wall and to prevent excessive hydrostatic pressures from developing. Typical backfill and anchor system details are shown on Drawing C-34 of Appendix 1 of Volume I.

During construction, the specifications require the sheet pile wall to be installed by driving. The Contractor will be responsible to supply a detailed control plan to prevent the loss of contaminated material from the shoreline/riprap area. Furthermore, to prevent the disturbance of potentially PCB-contaminated sediments, sheet pile wall installation should be conducted during low tide conditions. Regardless, the Contractor must provide protection such as either the local turbidity curtain or a silt fence (if the area is dry) around the sheet pile wall installation or other approved methods that are more protective as required in Specification 02375.

In the area that encompasses the off load excavation and the southern corner of the property, significant shoreline is not exposed at the base of the slope during low tide. Therefore, an additional method of preventing mobilization of contaminated sediment is required. The Contractor shall provide the Supervising Contractor/Site Construction Manager with a detailed plan in the RAWP, such as installation of a temporary silt curtain in the vicinity of the work area, to contain the disturbed sediment during the installation of the sheet pile wall. Such a plan should include the type and method of installation, containment and disposal of contaminated material for the Supervising Contractor/Site Construction Manager's review prior to commencement of installation work. Upon the Supervising Contractor/Site Construction

Manager's approval, such a plan could provide the Contractor with a longer work schedule beyond the tidal fluctuation opportunity to work along the entire length of the wall.

AMEC has concluded that steel would be the best material for construction of the sheet pile wall. This decision was based on the drivability of the material through the existing subsurface at the site. Geotechnical borings within the vicinity of the wall revealed a significant amount of gravel and/or riprap, through which it is difficult to drive a vinyl or fiberglass section. The advantage of steel is its structural strength, and steel is the choice for this application. Steel sheet pile walls are common on the Delaware River and have a typical lifespan of over 25 years. Inspection of the wall is included in Volume 2, Operation & Maintenance Plan and Institutional Controls Plan, Section 5.7.

### 4.9.2 Erosion Control Structures

A site visit was conducted on June 22, 2001 to determine if significant shoreline erosion is presently occurring or had occurred in the past beyond the limits of the sheet pile wall. The observations indicate that the slopes were sufficiently stable at the time of the inspection. To determine the impact from adjacent sediment excavations, four cross sections were constructed and slope stability analyses were performed. The calculations and results are included in Appendix 6 of Volume I. In addition, the outslope from the site has been designed to include four riprap outfalls. The outfalls are shown on Drawing C-12 of Appendix 1 of Volume I. The outfalls consist of a riprap-lined channel, lined with geotextile and surfaced with a riprap layer. Site drainage in the area of the channels is directed with small field-fit swales to flow to the channels.

## 4.10 Underground Storage Tank Closure

In accordance with Section IX.D.1 of the ROD, during the PDI, AMEC located and uncovered the UST located in the Southern Area, as shown on Drawing S-2 in Appendix 1 of Volume I.

The details of the investigation are conveyed to the Contractor on Drawing C-2 of Appendix 1 of Volume I, with the directives of what is required to complete the UST closure. Additional details, including tank size, cover material, and materials of construction, are presented on Drawing C-22 of Appendix 1 of Volume I. Detailed specifications have been developed to ensure the tank closure is performed in accordance with applicable regulations, including 40 CFR Part 280 Subpart G. The tank contents, if solid, will be required to be disposed of in accordance with applicable regulations or, if liquid, treated onsite with the water treatment system. Tank excavation soil sampling will not be required because the tank is within the limits of SA-4/5, which will be required to be excavated. The tank closure will be scheduled to take place at the beginning of the soil excavation activities in area SA-4/5. The tank closure specifications section is included in Volume III of the Revised Design. The design assumes that the Site Owner performed any necessary PADEP notification and closure requirements when the tank was abandoned and it will not be necessary to repeat these procedures.

## 4.11 Southern Area Soil Excavation

In accordance with Section IX.A.2 of the ROD, the soil sampling program for the Southern Area was conducted as part of the PDI to further refine the volume estimates and extent of soils exceeding the 25-ppm action level for PCBs established in the ROD that were identified during the RI/FS. Soil samples were collected around the outside perimeter of the areas of concern to determine the boundaries and limits for future remediation. The results of the sampling effort during the PDI were successful, and the boundary and limits for future Remedial Design were determined. The area is slightly larger than the area identified in the ROD. Information obtained from the pre-design samples has been used to develop the final design criteria for excavation, staging, waste disposal, and restoration of impacted soils in the Southern Area. As referenced in Section 3.3 above, the Revised Remedial Plan includes revisions to the Southern Area excavations that are detailed in Section 3.3.5.

Three areas of concern were identified for excavation based on the sampling results of the PDI. Drawing C-4 in Appendix 1 of Volume I shows the limits of the soil excavation that will be

required to be performed by the Contractor as part of the remedial action for the areas of concern. Volume estimates for each area are included in Appendix 5 of Volume I. The Contractor will be required to survey the area and lay out the excavation with survey stakes prior to excavation and to excavate to the contours shown on Drawings C-6 and C-7 in Appendix 1 of Volume I for each area of concern. Drawings C-15 and C-16 in Appendix 1 of Volume I show excavation cross sections. The Contractor will also be required to survey the area upon completion and obtain the Supervising Contractor/Site Construction Manager's acceptance of the survey prior to placement of backfill except for the excavation bottom of the E7 area within SA-4/5. During Pre-Final Design and per the Revised Remedial Plan, specifications for the Earthwork and for Sampling and Analysis required during construction were refined. These specifications outline the procedures described above. The construction specifications sections are included in Volume III of the Revised Design.

As part of the Revised Remedial Plan, verification samples will be collected within the Southern Area excavations SA-2 and SA-4/5. The results of these samples may cause the SA-2 excavation to increase in depth and the SA-4/5 excavation to increase laterally toward the mudflat and Delaware River. The construction specifications Sections 02210 and 02410 that are included in Volume III of the Revised Design provide further detail.

## 4.12 Floatable Oil/LNAPL Monitoring System

In accordance with Section IX.C.2 of the ROD, as part of the PDI, AMEC conducted a floatable oil/LNAPL investigation at the site, which included installing piezometers and measuring for oil. The piezometers were installed along the water side perimeter of the site to determine if floatable oil/LNAPL is present on the water table at the site along the proposed alignment of the oil collection system as required by the ROD. The investigation was designed to determine the existence, extent, and relative apparent thickness of any LNAPL that may remain at the site.

During the final floatable oil/LNAPL measurement, the recorded results indicated that three wells contained measurable floatable oil/LNAPL and three wells contained a presence or sheen

of floatable oil/LNAPL. All of these wells were located in a limited, small portion of the site. Based on the limited amount of oil present at the site, the PRP Group Respondents and AMEC proposed an alternative to the oil collection system identified in the ROD.

Based on the Preliminary Design report submitted in March 2000 and the FFS conducted by CDM, the USEPA issued ESD #2 on December 18, 2000 modifying the original remedy component of installing an oil collection system along the perimeter of the Metal Bank property. Based on ESD #2, an LNAPL monitoring system will be installed in this area following completion of soil excavation activities. Based on the ESD, the following revisions have been made to the design.

The ESD indicates that the area of excavation will be monitored. If oil is present and flowing in from the sidewall in 1/16-inch (or greater) thickness covering the water table after 2 to 3 days of stabilization, the side wall in the source area will be excavated. AMEC believes this approach should be evaluated during construction and the Supervising Contractor/Site Construction Manager should consider proposing alternatives to the USEPA. Any alternatives would require the USEPA's approval.

A layer of stone will be installed in a part of the SA-4/5 excavation area after excavation is complete, and four 24-inch-diameter perforated polyethylene sumps will be installed in an LNAPL monitoring trench. The stone will be installed along the river side of the excavation and will include a 48-inch-thick, PennDOT size (AASHTO No. 1) washed stone layer centered at the groundwater interface as shown in Drawing C-23 of Appendix 1 of Volume I. This thickness has been increased due to the USEPA comments regarding the fluctuation of the groundwater table in this area. A second element will consist of extending the trench away from the SA-4/5 excavation in the direction of BP-3 and to BP-10 as shown on Drawing C-7 in Appendix 1 of Volume I. The trenches will be extended to the point where some oil was encountered. Sumps will be extended to grade and will be finished at grade with concrete vaults, as shown on Drawing C-23 of Appendix 1 of Volume I. The sump will be monitored visually for the presence of oil on a bi-weekly basis for the first quarter of installation and on a quarterly basis

thereafter in conjunction with the groundwater monitoring required by the ROD. In the unlikely event that a mechanical oil collection system would be required, the monitoring sumps could be adapted to serve as an oil collection system. The specifications for the LNAPL monitoring have been included in Volume III of this Final Design.

As part of the comments on the Intermediate Design, the USEPA recommended the installation of a geotextile that would allow water to pass through the interceptor trench but retain oil within the trench. AMEC contacted numerous geotextile manufacturers and was unable to locate a large sheet product intended to be installed in a trench and made for direct burial that will impede the flow of oil and allow water to flow through the trench. During the stabilization period, sorbent booms and pads will be utilized to collect and remove any free oil present on the SA-4/5 excavation surface.

## 4.13 Soil Disposal

In accordance with Section IX.B of the ROD, during excavation, the Contractor will be required to stockpile separately soils expected to exceed 50 ppm of PCBs from soils that are possibly above 25 ppm but not above 50-ppm PCBs. Overburden or existing cover soils, which are expected to be below 25 ppm, will also be separated. Soil will be stockpiled in approximately 150-cubic-yard piles, and a composite sample will be collected from each pile by the Contractor for PCB analysis at a USEPA-approved laboratory in accordance with the Sampling and Analysis Plan in Volume II. All soil sampling will be performed under the inspection of the Supervising Contractor/Site Construction Manager. The result of the analysis for each soil pile will be used to determine the offsite disposal required for the soil. Based on the USEPA's directive, with the exceptions identified in Section 3.3.5.E, all soil excavated from the Southern Area and previously defined as the hot spots, that has concentrations below 50 ppm of PCBs, and that also is non-hazardous will be disposed of in a Subtitle D landfill. Soil tested to have PCB concentrations above 50 ppm will be disposed of in a TSCA-regulated landfill.

The ROD indicates that the soil must be tested for other disposal characteristics to determine if soil below 50 ppm of PCBs is required to be disposed of in a Subtitle D Landfill or a Pennsylvania Residual Waste Landfill or if hazardous for other constituents in a Subtitle C RCRA Hazardous Landfill. During the PDI, Courtyard Area surface soil samples and Southern Area soil samples were analyzed for full TCLP and asbestos for disposal characterization purposes. No constituents were detected in the samples analyzed for TCLP at concentrations exceeding the USEPA Regulatory Levels contained in 40 CFR §261.24. Asbestos was detected at a concentration of less than 1 percent in three soil samples from the Southern Area: MB-SAB-11-06, MB-SAB-15-08, and MB-SAB-19-09. None of the seven remaining samples contained detected concentrations of asbestos.

These results will be made available to the Contractor. Based on these results, it is believed that the soils below 50 ppm of PCB at the site are not hazardous and will be required to have additional TCLP or other disposal analysis only to the extent that it is required by the Contractor's disposal facility. During Pre-Final Design, specifications for sampling and analysis were developed. The specifications outline the sampling requirements that the Contractor will need to follow to classify the soil before disposal. The specifications also detail soil disposal procedures for the Contractor. The Contractor will be required to comply with the notification requirements of the Utility Consent Decree.

The Contractor will also comply with the Revised Remedial Plan for soil disposal. The Revised Remedial Plan states that all excavated soil from Courtyard Areas CY-1 and CY-2 and from SA-2 and SA-3 in the Southern Area will be disposed of offsite.

The Contractor will also comply with the agreed upon RCRA/TCLP sampling of excavated sediments, as mentioned in Sections 3.3.6 and 3.4 above. Based on the results, if the sediments are characterized as non-hazardous then they can be used for onsite grading purposes. If hazardous, then the sediments will need to be disposed of in a Subtitle C RCRA Hazardous Landfill and the sediments may require other disposal analysis only to the extent that it is required by the Contractor's disposal facility.

## 4.14 Soil Cover Installation

In accordance with Section IX.A.6 of the ROD, the installation of a 12-inch soil cover in the Courtyard Area and a 24-inch soil cover in the Southern Area is required. Per the Revised Remedial Plan, the Contractor is to also install an additional 24-inches of soil cover in the E4 area as shown on Drawing S-4 in Appendix 1 of Volume I. The final cover will be graded with a 1% slope to facilitate adequate surface drainage.

Pennsylvania Residual Waste Management (PRWM) Regulations at 25 PA Code §288.234(g) state that:

> Unless the Department authorizes a different slope design in the permit based on a demonstration that the different design can meet the requirements of subsection (f), Slopes shall be designed, installed and maintained as follows:
>
> (1) The final surface of the facility may not be less than 3%.

PRWM Regulations at 25 PA Code § 288.234(f) state that the grade of final slope shall be designed, installed, and maintained to accomplish the following:

> (1) Ensure permanent stability.
> (2) Control erosion due to rapid water velocity and other factors.
> (3) Allow compaction, seeding and revegetation of cover material placed on the slope.
> (4) Ensure minimal infiltration and percolation of precipitation, surface water run-on and runoff into disposal area.

The 3% minimum slope requirements mentioned in §288.234(g) are based on anticipated settlement of municipal residual waste. Based on settlement calculations attached in Appendix 4

of Volume I, there is no significant settlement anticipated at the site. Based on the stable condition of the site for over 25 years and these settlement calculations, a 1% slope will meet all the requirements of PRWM Regulations at 25 PA Code §288.234(f). These settlement calculations were revised with the Pre-Final Design to include additional preparatory grading fill in accordance with the USEPA comments on the Intermediate Design.

Site soils will be used for preparatory grading purposes to the extent that the grading activities do not significantly disturb the surface. Excavated Courtyard soils from areas other than CY-1 and CY-2 that were found to contain PCBs at concentrations below 25 ppm and excavated sediments will also be used for preparatory grading purposes. A minimum of imported fill will be utilized for preparatory grading purposes, if required.

As part of the preparatory grading activities, the excavations must be filled with soil to bring them back to existing grade. Sediments excavated from the Delaware River will be used for this purpose. Prior to use for grading purposes, excavated sediment stockpiles shall be sampled for RCRA TCLP analyses as mentioned in Section 3.3.6 above. The sediments will be placed in the upland excavations in approximate 12-inch lifts and properly compacted. The broken concrete from the existing stockpile will be installed to help stabilize and compact the sediments. It may be necessary to perform dewatering of the sediments by installing a sump in the excavation or allowing them to drain above grade prior to placement within the excavation. This dewatering activity will be performed in a controlled fashion and any water draining from the sediments will be collected and disposed of offsite or treated through the water treatment system and discharged to the sanitary sewer system in accordance with the permit requirements and Specification 01501 Construction Water Management in Volume III.

The preparatory grading plan is shown on Drawings C-8 and C-9 of Appendix 1 of Volume I. Once the areas are properly graded, a lightweight geotextile will be placed over the graded material to serve as a marker between the site soils and cover soils. The geotextile will be used to provide a uniform consistent barrier as required by ESD #1 issued on September 27, 2000.

The geotextile will also allow for verification of the 2-foot soil thickness and prevent the mixing of site soils with cover soils.

The cover soils will be specified and placed in a northwest to southeast direction so that cross contamination of the clean cover soil does not occur. Cover soil placement will be specified after sediment excavation and placement is complete. Cover soil will be specified to include materials meeting the requirements of Pennsylvania Code Title 25, Waste Management Regulations. In addition, the USEPA has provided additional cover soil requirements. The relevant sampling and analytical requirements have been incorporated into the specifications. Analytical requirements are the USEPA clean soil requirements provided by BTAG and found in Volume III, Appendix B.

The vegetation specifications will require the testing of the cover soil to determine the adequacy for vegetation. In the event that the cover soil does not contain adequate organic materials to support vegetation, soil amendments will be specified. Specification sections for the geotextile, cover soil, and revegetation are included in Volume III.

### 4.15 Delaware River Area Sediment Excavation and Sub-Aqueous Cap

In accordance with ROD Section IX.A.3, ESD #2 issued on December 18, 2000, AO paragraph III.E.4.a, and the Revised Remedial Plan, the Delaware River area sediment excavation and backfill design is intended to satisfy the following objectives:

- Remove contaminated sediments exceeding target PCB levels of 1 ppm within 75 feet of the site and within reach of land-based excavation equipment
- Prohibit contaminant migration caused by resuspension of contaminated sediments
- Minimize time required for construction
- Minimize impacts to the surroundings during construction.

The sediment excavation design will also contain scheduling and operational specifications that meet the intent of all local, state, and federal regulatory requirements. Accommodation of vessel traffic and coordination with other activities occurring in the project area will be required.

### 4.15.1 Sediment Excavation Limits

Delaware River Area sediment sampling was undertaken during the PDI and the USEPA's 2003 Pre-Remedy investigation to supplement existing data and to further delineate the horizontal and vertical extent of PCB concentrations in the sediments exceeding the 1-ppm action level. Review of the data indicates that levels of contamination are higher near the southwest and southeast corners of the site and decrease away from those areas. Drawing C-32 in Appendix 1 of Volume I presents the excavation limits and is based on the PDI data, March 2000 Preliminary (30%) Design, AMEC's letter of October 26, 2000, USEPA response letters of September 8, and December 18, 2000, and the Revised Remedial Plan. Per the Revised Remedial Plan, the limits of excavation will be 75 feet from the shoreline in the areas shown on Drawing C-32 using land-based equipment. The RAC's means and methods will be provided in the RAWP.

Depth of sediment excavation is based on the USEPA's 2003 Pre-Remedy Investigation data and the PDI data supplemented by the RI data. In general, the depth of remediation for most of the area adjacent to the southwest corner of the site is 2 feet. The PDI data indicate one zone where excavation will need to extend to 4 feet, and this is supported by the RI data. Data collected during the RI in the riprap zone along the southwest corner indicate some areas with contamination above 1 ppm, but well below 25 ppm to depths below 2 feet. These areas will be contained behind the sheet pile wall being placed at the toe of the slope.

### 4.15.2 Sediment Excavation

Sediment excavation will be performed using land-based equipment (extended reach hydraulic excavator). A backhoe may be used in the mudflat area under dry conditions at low tide. The

primary purpose for this restriction is to minimize the amount of sediment suspension during operations. Although elutriate testing during the PDI showed no PCBs in the elutriate water and only minimal (parts per billion, ppb) levels associated with the elutriate sediment, low-impact techniques will further lower the potential for contaminant migration during excavation.

Upland equipment utilized onsite will be subject to a 150 pounds per square foot load limit in the vicinity of the shoreline sheet pile wall that will be constructed. Loads in excess of this limit must remain at least 30 feet back from the edge of the wall on the upland side of the sheet pile wall in accordance with the drawings and specifications. Considering these restrictions, the Contractor will be responsible for determining the applicability of various land-based construction methods. The Contractor will be free to construct temporary load-bearing improvements to the wall, provided they meet the approval of the Client, the Supervising Contractor/Site Construction Manager, and the Engineer. The Contractor will be responsible for any placement of loads in excess of the maximum specified limit. In addition, based on the additional soil excavation anticipated between the SA-4/5 area and the sheet pile wall, it may be necessary to move excavated sediment around the sheet pile wall with a temporary access road.

### 4.15.3 Backfilling of Sediment Excavation

All areas of sediment excavation will be backfilled with at least 1-foot of clean material that meets the requirements of Section 02900 of Volume III Construction Specifications. The backfill will consist of placing a non-woven geotextile followed by 1-foot (minimum) of PennDOT R-3 riprap stone material. Consequently, the likelihood of erosion of this material will be reduced, however, the benthic habitats may be significantly altered. The specification for Sediment Excavation and Sub-Aqueous Cap (Section 02900) in Volume III indicates the type of materials that should be used for backfilling of the excavation area. Specifications of the sand material used for the designated sampling zones are to be provided in the Long-Term Monitoring Plan that will be submitted under separate cover. The Contractor will be required to submit representative samples and laboratory testing results for approval by the Supervising

Contractor/Site Construction Manager of its proposed backfill prior to construction. The Contractor will be required, at its own expense, to remove any backfill delivered to the project area that is not consistent with the approved representative samples.

Prior to backfilling, excavation areas will be surveyed to confirm that the excavation has extended to at least the boundaries defined by the Excavation Area Control presented on Drawing C-32 of Appendix 1 of Volume I and at least to the depths presented. Placement of backfill material will be performed using a clamshell bucket, backhoe, or other acceptable excavation equipment that can perform the work in a low-impact, environmentally sound manner. Rate and techniques of placement are restricted in the specifications to minimize the resuspension of bottom sediments during placement. This approach needs to be further evaluated during construction and the Supervising Contractor/Site Construction Manager should consider proposing alternatives to the USEPA. Any alternatives would require the USEPA's approval.

Turbidity control will remain in effect during sediment excavation and backfill placement within excavated sediment areas and areas receiving only the riprap backfill material. Other areas previously identified for sediment excavation outside of the 75-foot sediment excavation will receive sub-aqueous marine mattress cap material as stated below. These areas are shown on Drawings C-32 and C-33 of Appendix 1 of Volume I. After backfill placement the excavation area will be visually inspected and surveyed by conventional/bathymetric means to confirm placement to the required lines and grades of the sediment backfill. The RAC will collect samples of the backfill material to be analyzed for Total PCBs Aroclor to demonstrate that the backfill material was properly placed in accordance with the specifications. Details of the above sampling and designated sampling zones are to be provided in the Long-Term Monitoring Plan that will be submitted under separate cover.

### 4.15.4 Riprap Buttress Placement

All down-gradient areas of the sub-aqueous cap will be backfilled with a riprap buttress in accordance with the drawings that meets the requirements of Section 02900 of Volume III Construction Specifications. The buttress will consist of placement of a PennDOT R-6 riprap stone material within the areas and to the grades set forth in the drawings. The riprap buttress will likely aid in the prevention of erosion of the sub-aqueous cap material and provide some stability against sliding of the sub-aqueous cap material. The specification for Sediment Excavation and Sub-Aqueous Cap (Section 02900) in Volume III indicates the type of materials that should be used for the buttress area. The Contractor will be required to submit representative samples and laboratory testing results for approval by the Supervising Contractor/Site Construction Manager of its proposed riprap prior to construction. The Contractor will be required, at its own expense, to remove any backfill delivered to the project area that is not consistent with the specifications or the approved representative samples.

### 4.15.5 Sub-Aqueous Cap Placement

The marine mattress sub-aqueous cap placement will be in accordance with the drawings that meets the requirements of Section 02900 of Volume III Construction Specifications. The marine mattresses sub-aqueous cap system will include 12-inch thick marine mattresses consisting of high-strength geogrid panels that are laced together to form mattress-shaped “cages”. The mattresses will be filled with a PennDOT R-3 riprap stone material and a geotextile panel will be attached on the bottom of the mattress to serve as a filter fabric. The mattresses will be constructed either onshore or on the barge deck and placed with a crane. The mattresses will be laced together and will contain a 4-inch maximum gap between each mattress. The gaps between mattresses will have additional geogrid panel and geotextile filter fabric to provide stability and meet filter criteria. The specification for Sediment Excavation and Sub-Aqueous Cap (Section 02900) in Volume III indicates the type of materials that should be used for the sub-aqueous marine mattress system. The Contractor will be required to submit representative

samples and laboratory testing results for approval by the Supervising Contractor/Site Construction Manager of its proposed marine mattress system prior to construction. The Contractor will be required, at its own expense, to remove any mattress material delivered to the project area that is not consistent with the specifications or the approved representative samples. The RAC should address any contingency concerns including marine mattress gap separation greater than 4 inches within their work plan.

### 4.15.6 Upland Placement of Dredged Material

In accordance with Section IX.A.6 of the ROD, dredged material containing less than 25 ppm of PCBs will be placed at upland location(s) on the Southern Area of the site. The primary placement location will be Area SA-4/5 following removal of the upland contaminated materials. Due to the high silt content (80 percent on average) of this material, layers of the dewatered sediment will be alternated with crushed rock or onsite fill during compaction.

Data collected during the PDI indicate that all sediments to be excavated have PCB levels well below the 25-ppm criterion, are not hazardous, and do not contain asbestos. The water collection and water treatment system used for groundwater control during the upland excavation will also be used to manage any excess water associated with upland placement of the excavated sediments. Elutriate test data from the PDI will be provided so the Contractor can incorporate that information into the development of the water treatment system to be used unless the Contractor elects to dispose of contained water at an approved offsite facility. Treated water will be discharged to the PWD sanitary sewer inlet (if elected).

The Contractor will be responsible for determining appropriate methods for the transport of excavated material from the excavation site to the disposal site and placement of the material primarily in area SA-4/5. Upland load restrictions in the vicinity of the shoreline retaining wall allow for limited use of construction equipment. These restrictions are further specified in the

contract documents. In addition, the development of the upland dewatering and placement of dredged sediments is addressed in the specifications.

### 4.15.7 Turbidity Control

Control of turbidity during excavation operations will be accomplished with local turbidity curtains. This alternative was determined to be more implementable and cost-effective compared to structural solutions such as a sheet pile wall cofferdam. Advantages of the local turbidity curtains include its relative ease of construction, ability for adjustment, limited disturbance of bottom sediments during installation and removal, and significant savings in cost and construction schedule. It is recognized that the effectiveness of local turbidity curtains is limited by environmental conditions such as currents and tidal range; however, the conditions in the project area are sufficiently mild to allow a properly engineered system to perform adequately. The need to impose operational restrictions, such as excavation windows to avoid excessive tidal currents and limiting operations during storm events, has been evaluated and incorporated into the design. These operational restrictions are intended to limit construction delays caused by damage to the local turbidity barriers.

Drawings C-35 and C-37 in Appendix 1 of Volume I illustrate final local turbidity curtain design details and siting. Current and tidal conditions require that a local turbidity curtain be deployed during all excavation operations.

**Local Turbidity Curtains.** The local turbidity curtains shall be constructed of a medium-strength material designed to withstand mild wind, waves, and current. Local turbidity curtains will be deployed around the limits of each of the excavation areas during excavation activities. However, all excavation operations must cease as required to reduce turbidity prior to such curtain openings. A local turbidity curtain must also enclose all offloading operations undertaken to transport material to the upland if necessary to control turbidity. The local turbidity curtains should be positioned a minimum of 10 feet from the excavation equipment

during excavation and disposal operations. Recommended details of the anchoring systems for the local turbidity curtains may be found on Drawing C-37 in Appendix 1 of Volume I.

**Operational Restrictions**. It is recognized that the effectiveness of turbidity curtains decreases with increases in water currents. Consequently, excavation and fill operations may be prohibited during extreme portions of the tidal current cycle and during flood periods.

The turbidity monitoring will be performed by the Contractor as described in Specification 01441 Turbidity Monitoring in Volume III. One background turbidity monitor will be installed at a distance from the site to provide background turbidity levels. The turbidity monitoring positions will vary depending upon the Contractor's phased sediment excavation activities with the exception of the one background location. All turbidity monitors, except the background location will be within 100 feet of the local turbidity curtains.

For at least 7 days prior to the start of the excavation phase, the turbidity monitors will record data. These data will be used to compare the onsite turbidity results to the offsite results. The offsite location will be deemed suitable if its data prove similar to the data sets collected at the onsite monitors. The turbidity instruments will be deployed 3 feet from the river bottom, which is far enough from the bottom to avoid insignificant, localized, naturally occurring turbidity (e.g., from fish movement), while remaining in the zone where construction-related turbidity is most likely to be found.

## 4.16 Delaware River Current Data

With ESD #1, the USEPA approved the elimination of the sheet pile cofferdam and the use of turbidity curtains. The Revised Remedial Plan reduced the use of turbidity curtains to include only local turbidity curtains. To design the turbidity curtains, it was necessary to gather site-specific information regarding the currents and tides in the areas where sediments will be excavated. To do this, AMEC and Hart Crowser submitted a plan to the USEPA in October 2000 for collection of these data. AMEC contracted with Aqua Survey, Inc. to collect the

Delaware River data and managed the collection of the data. The Delaware River current data were collected by Aqua Survey, Inc. between November 8, 2000 and December 7, 2000. Data were collected at three locations in the Delaware River, and the results of this effort were included in Appendix 6 of the Intermediate Design report. As reported by the USGS (http://md.water.usgs.gov/publications/press_release/current/), stream flows in the Delaware River for the months of November and December were at normal to above normal for that time of year.

During data collection, readings were taken at a frequency of every 10 minutes and were measured in 1-meter intervals as indicated on each data cover sheet. No problems were encountered with the data collection, and all three meters operated throughout the collection period.

A preliminary statistical analysis was performed to determine the maximum current flows, the corresponding directions (ebb or flood tide), and the frequency of each occurrence. In the design of the turbidity barrier, the critical flow rate has been estimated as 1.5 to 2.0 fps. Overall, less than 4 percent of all currents measured throughout the month period were found to be greater than 2.0 fps. In addition, these currents were measured during peak flood tides. This is contrary to normal flow as the ebb tide is generally greater than the flood tide, as it is superimposed with the natural flow of the river. During this period, tidal elevation measurements revealed an average fluctuation of 6.5 feet. The collected data were used to design and specify the local turbidity curtains.

### 4.16.1 Sub-Aqueous Cap Material Evaluation

As mentioned above in Sections 3.3.6 and 3.4, the USEPA and the PRP Group agreed to substitute the previously approved sediment cap material for a riprap stone material. As also referenced in Section 3.4.4, the PRP Group has proposed to substitute the riprap stone material with a marine mattress system that incorporates the previously agreed upon riprap stone material.

Therefore, the agreed upon designation of a PennDOT R-3 size stone is still the most appropriate stone material size for incorporation into the sub-aqueous marine mattress cap. The R-3 stone size is consistent with a gradation of a maximum of 6 inches, a minimum of 2 inches, and a $d_{50}$ of 3 inches for the riprap. During the preparation of the February 16, 2007, version of the Revised Design, the PRP Group had modified the cap to include a minimum of 6 inches of coarse aggregate material sub-base below a minimum of 18 inches of R-3 stone material for a total minimum cap thickness of 2 feet. The sub-aqueous cap has been modified to be a 1-foot thick marine mattress with R-3 stone and a geotextile filter fabric on the bottom panel of the mattresses. The evaluation of the R-3 riprap stone versus Delaware River flows presented below and also presented in the February 16, 2007, version of the Revised Design is still applicable.

The PRP Group has evaluated the R-3 riprap cap material relative to river current data from the PDI that was obtained in November and December of 2000, representing approximate base flow conditions during that period. This data is the only field measured data that AMEC currently possesses. Using the maximum velocities at each depth over the flow measurement period, an analysis was conducted to assess the stability of the riprap under these conditions in terms of a Factor of Safety (FS) (Please refer to Appendix 7). For base flow conditions, PRP Group obtained FS values between 2.8 and 3.0 that the R-3 riprap cap material will remain in place. These FS values do not apply to large storm events, upriver basin snow melt events, or the movement of riprap material due to cap settlement. These FS values also do not account for the marine mattress containment of the R-3 riprap which would provide increased FS values under normal flow conditions.

The PRP Group conducted a similar stability analysis on the R-3 riprap cap material for the 100-year flood event. The 100-year flood elevations, obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Philadelphia, PA (effective August 2, 1996), were used to estimate flood depths. The slope of the energy grade line, which can be related to 100-year flood velocities using the Manning's Equation, was also estimated from the FEMA flood maps. For the 100-year flood, the PRP Group obtained FS values between 1.4 and 1.6, indicating that the R-3 riprap cap material will remain in place (Please refer to

Appendix 7). These FS values also do not account for the marine mattress containment of the R-3 riprap which would provide increased FS values under 100-year flood flow conditions.

The stability analysis for the 100-year flood is very simplified and should not be interpreted as providing a high degree of certainty that the R-3 riprap cap material would remain in place under high flow conditions. If stability under 100-year or other rare flooding conditions is a concern, the stability of the R-3 riprap cap material should be re-evaluated based on a more detailed hydraulic analysis for ebb and flood conditions along the Delaware River in the vicinity of the project.

## 4.17 Fence Installation

The existing fence is in poor condition and does not surround the entire site. In accordance with Section IX.E.1 of the ROD, a new 6-foot-high galvanized steel fence will be installed around the entire property. Drawings C-17 and C-18 in Appendix 1 of Volume I provide the location and details of the chain-link fence. The Contractor will be required to install the chain-link fence around the land-bound portions of the site at the beginning of construction. The waterfront portion of the chain-link fence will be required to be installed at the completion of construction so as to prevent damage of this area during construction activities and to allow the fencing to be installed after the final grading and cover soil installation has been completed.

The existing gates will be replaced with similar gates. In addition, one gate will be specified to be added at the main construction entrance along Milnor Street for truck traffic.

The other element of institutional controls includes deed restrictions, which are required to be placed on the property. Deed restrictions are the responsibility of the Property Owner and are not addressed as part of this Revised Remedial Design.

## 4.18 Signs

In accordance with Section IX.E.2 of the ROD, signs will be posted along the property boundary, including the river side, on the chain-link fence and will provide a warning regarding PCBs. The exact wording and placement of the signs is included in the specifications in the "Chain Link Fence" section for review by the USEPA, PADEP, and the Fish and Boat Commission. The signs will be mounted to the chain-link fence; the specification includes requirements for sign spacing.

## 4.19 Groundwater Monitoring Program

Section IX.G.1 of the ROD requires a monitoring program for site groundwater to evaluate the effectiveness of the remedy in reducing concentration of PCBs and other contaminants in groundwater. Details of the monitoring program that the Contractor must implement are provided in the Sampling and Analysis Plan. The MW-4, MW-6, and MW-7 monitoring well locations will be abandoned. Six new proposed monitoring wells will be installed at the site and sampled per the Sampling and Analysis Plan in Section 3 of Volume II. The proposed new monitoring wells and the monitoring wells to be abandoned are displayed in Drawing S-4 in Appendix 1 of Volume I. A monitoring well construction detail is displayed in Drawing C-22 in Appendix 1 of Volume I. The construction specifications sections are included in Volume III of the Revised Design. Detailed information on the monitoring will be provided in the Long-Term Monitoring Plan under separate cover.

## 4.20 Delaware River Monitoring Program

Section IX.G.2 of the ROD requires a monitoring program for the Delaware River to evaluate conditions in the Delaware River at the site after the remedy has been implemented. The details of the chemical monitoring and sub-aqueous cap survey program are included in the Sampling and Analysis and the Operations and Maintenance Plan (Volume II). The proposed sediment monitoring locations are displayed in Drawing S-4 in Appendix 1 of Volume I. Details of the monitoring and the designated sampling zones in and around the marine mattress locations are to be provided in the Long-Term Monitoring Plan that will be submitted under separate cover.

# 5.0 CONSTRUCTION SEQUENCE AND SCHEDULE

This section includes a discussion of the sequence of construction and a proposed or example schedule for the remedial action. This construction sequence and schedule may change based on the Contractor's methods, but is intended to help develop an understanding of the overall comprehensive design package.

## 5.1 Pre-Construction Activities

Prior to construction, the Contractor will be required to provide the submittals and work plans required by the Utility Consent Decree and the specifications and also to obtain any required local permits. Subcontractor qualifications will be required to be submitted for USEPA approval prior to any subcontract work onsite. All activities will be performed in accordance with the approved Work Plans. The specifications include a provision for the notification of St. Vincent's School and the Quaker City Yacht Club.

## 5.2 Mobilization

The first element of construction will be mobilization. Mobilization will include establishment of the USEPA Representatives, Supervising Contractor/Site Construction Manager's, and Contractor's office trailers as well as preliminary access and control facilities. Once mobilization is completed, the preliminary elements of construction will include the installation of the inland portions of the perimeter security fence and the establishment of perimeter sediment and erosion controls.

The next stage of construction will include the construction of water management facilities and the construction of the soil stockpile area and decontamination pad. These construction activities will be performed while accessing the site through the existing gates to minimize traffic across contaminated soils in the Courtyard Area.

## 5.3 Upland Area Construction Sequence

Once these steps are established, the Courtyard area clearing and grubbing and soil excavation will proceed. The Courtyard soil excavation will be followed by the backfilling of the excavation, and installation of the 12 inches of cover soil in the Courtyard Area. The Courtyard Area will be required to be vegetated within 21 days of completion of the soil cover installation. This process will complete the Courtyard Area activities and isolate any potential PCB contamination below 10 ppm prior to construction traffic in this area. The construction access road will be installed and construction will then proceed.

Once these areas are established, the sheet pile wall will be installed in the Southern Area. Simultaneously with the sheet pile wall installation, the power washing and sealing of Building 7 can be performed. This will allow for limited dust from trucking operations to hamper the sealing activities within Building 7. Any necessary clearing and grubbing in the Southern Area and demolition activities shown on the drawings will proceed next and concurrent with excavation of Areas SA-2 and SA-3. The UST closure and the excavation of soil in Area SA-4/5 will be the final excavation activities. As excavation occurs, the smaller excavation areas in the Southern Area could be filled with any excavated soil that was excavated to remove soil greater than 10 ppm or 1 ppm, but stockpiled and tested to be below 25 ppm from the Courtyard Area or excavated sediments. If excavated soil from the Courtyard Area is used to fill the smaller excavation areas, it must be from outside of the CY-1 and CY-2 courtyard excavation areas, contain less than 25 ppm of total PCBs, placed at least 100 feet from the river and mudflats, at least four feet above the top of the groundwater table, and beneath the soil cap.

Excavation activities will proceed until the completion of the SA-4/5 excavation and the removal of any LNAPL that is encountered. The LNAPL monitoring specifications include monitoring provisions during the stabilization period. The larger excavation will be backfilled with sediments excavated from the Delaware River. Sediment excavated from the Delaware River will be allowed to drain on the site in a drainage area with free water collection behind the silt fence and then placed in the bottom of the excavations in approximate 12-inch controlled lifts. Excavated sediments can only be used as backfill if specified contaminant concentrations are

met, as stated in Sections 3.3.6 and 4.13 above. The broken concrete pile will then be placed in alternating lifts within the excavation. Additional concrete from the soil stockpile and decontamination pads will also be allowed to be placed within the excavation once soil disposal activities are complete. When the SA-4/5 excavation is open, it will be monitored for LNAPL during a stabilization period as described in ESD #2.

After the excavations are backfilled, any additional sediment will be graded on the site to create the preparatory grades required prior to installation of the 2-foot soil cover. Once the preparatory grading is complete, the geotextile will be installed, the cover soil will be placed, the additional 2 feet of soil cover in Area E-4 will be placed, and the site will be vegetated.

## 5.4 River Area Construction Sequence

The intended construction sequence is to begin sediment excavation as soon as the Southern Area excavation activities are complete. Therefore, at the end of the excavation of the Southern Area soil, the local turbidity controls will be installed in the Delaware River. Turbidity monitoring will be conducted for at least 7 days before sediment excavation begins. Sediment excavation activities will then proceed down river and in towards the shore. Once excavation is complete, the backfill material and sub-aqueous cap will be installed in the excavated and non-excavated areas previously identified to contain more than 1 ppm of PCBs.

## 5.5 Post-Construction Activities

When the site construction activities are completed, demobilization will occur. As part of demobilization, as-built drawings will be prepared and a final construction report will be provided to the Client. At the completion of demobilization, the monitoring programs will commence until no longer required.

## 5.6 Construction Schedule

The Contractor will prepare and provide a construction schedule to the PRP Group Respondents and the USEPA for approval.

# 6.0 SUMMARY OF REVISED DESIGN

To provide a sound basis for preparation of the attached design, the PRP Group has performed regulatory reviews, product evaluations, industry standards reviews, design parameter analyses, and peer reviews. The drawings and specifications define the construction product. Project reviews have been performed throughout this design process to maintain quality control and to assure continuous communication with the USEPA in order to provide a deliverable that is in alignment with the USEPA's expectations.

## 6.1 Revised Design Submittal

The Revised Design submittal includes construction drawings and specifications for the Remedial Design at the Metal Bank Superfund site. The Revised Design package includes a design report with a description of how the design has been developed and the process for the design, as well as the construction drawings at the 100-percent design phase, the specifications for the project, and the required Work Plans.

Early in the design process, AMEC performed a regulatory review. Any discovered requirements were incorporated into the design. Based on this regulatory review, the Permitting Requirements Plan was prepared.

### 6.1.1 Revised Design Drawings

Revised Design drawings include the site drawings for the remedial action construction contract. The drawings present the layout of the project facilities showing location, dimensions, and alignment of components. Drawings are prepared to show the site, foundation plans, storage facilities, remediation activities, and remedial limits and details necessary to define and demonstrate the intended construction approach. Sizing of equipment and details are shown on the plans. The drawings are divided into four divisions, which include "T" or title drawing; "S"

or site plans drawings; "C" or civil engineering drawings; and "M" or mechanical engineering drawings. The drawings were developed on AutoCAD, Version 2004® and have been be prepared on "D" sized sheets (24 x 36 inches).

### 6.1.2 Revised Construction Specifications

AMEC has prepared construction specifications for the remedial action. The specifications are based on the Construction Specification Institute format, which divides the project work into 17 divisions numbered from 00000 to 16000. The specifications include all activities and components of the proposed work and are included in Volume III.

### 6.1.3 Revised Cost Estimate

A revised construction cost estimate has been removed from the Revised Remedial Design.

## 6.2 Design Deliverables

The Revised Design has been prepared to the 100 percent design level and is intended to propose the approach to construction, including the technologies and methods that will be utilized to achieve the goals and objectives of the ROD, ESD #1, ESD #2, and the Revised Remedial Plan. Submission of this document completes the Remedial Design and fulfills the Utility Consent Decree obligation to submit a Revised Final Design.

## 7.0 REFERENCES

AMEC and Hart Crowser, March 5, 2001, Metal Bank NPL Site, Intermediate Design Investigation Report, Volumes I through III. Prepared for Cottman Avenue PRP Group, Philadelphia, PA, by AMEC Earth & Environmental, Inc., Blue Bell, PA, and Hart Crowser, Inc., Jersey City, NJ.

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# APPENDIX 1

## Revised Design Construction Drawings

## (Attached Separately)

# APPENDIX 2

## Basis of Design for Marine Mattress Sub-Aqueous Cap Letter, Revised Remedial Plan, USEPA Comments, and Response Letters

1. **USEPA Comments on Pre-Final Design, May 15, 2002**
2. **AMEC Response to Comments, August 7, 2002**
3. **USEPA Comments on Pre-Final Design, August 2, 2002**
4. **AMEC Response to Comments, August 29, 2002**
5. **USEPA Comments on Pre-Final Design, September 10, 2002**
6. **AMEC Response to Comments, September 16, 2002**
7. **Revised Remedial Plan, June 29, 2004**
8. **USEPA Comments on the Revised Design, July 12, 2006**
9. **AMEC Response to Comments, August 14, 2006**
10. **PRP Group Summary Response Letter to USEPA, January 16, 2007**
11. **USEPA Comments to the Revised Design, July 20, 2007**
12. **Basis of Design for Marine Mattress Sub-Aqueous Cap, October 30, 2007**
13. **AMEC Response to Comments, November 9, 2007**

# APPENDIX 3

## Philadelphia Water Department Sanitary Sewer Discharge Requirements

# APPENDIX 4

## Settlement Calculations

# APPENDIX 5

## Soil Excavation Volume Calculations

# APPENDIX 6

## Sheet Pile Wall Design

### Part 1 – Soil Properties and Earth Pressure Calculations

### Part 2 - Sheet Pile Wall Calculations Using CWALSHT

### Part 3 – Wind and River Current Force Calculations

# APPENDIX 7

## Sub-Aqueous Cap Material Calculations Sheets